SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JUNE 1904.

GENERAL PHYSICS.

1242. *Diminution of Density of Metals by very High Pressures.* **W. Spring.** (Bull. Acad. Belg. pp. 1066–1082, 1903. Chem. Centralblatt. 1. pp. 776–777, 1904.—At very high pressures (over 10,000 atmospheres) a diminution of density is found to occur in some metals and other substances. Metals which expand on fusing, like tin, lead, cadmium, and silver, have their density increased, but bismuth, which contracts on melting, has its density increased at such pressures. Wires prepared by squeezing through dies were compared in the state as prepared and after annealing, and bismuth again gave the opposite effect when the same metal in the two states was used as a galvanic cell. The density of various metals after different treatments is given in the following table :—

Metal.	Density after Particles have been made to "flow."	Density of Rolled Metal.	Density of Annealed Metal.
Lead	11·3351	11·3348	11·3410
Tin	7·3011	7·3016	7·3137
Cadmium	8·6558	8·6603	8·6633
Silver	10·2485	10·2531	10·2696
Bismuth	9·8522	—	9·8354

A distinction should, the author thinks, be drawn between the "true" solid condition and the "apparent" solid condition. L. H. W.

1243. *Viscosity of Pitch-like Substances.* **F. T. Trouton** and **E. S. Andrews.** (Phil. Mag. 7. pp. 347–355, April, 1904. Phys. Soc. Proc. 19. pp. 47–56, Discussion, p. 57, May 1904.)—By applying a constant torque to a cylinder of the substance, and observing the relative motion of the ends, if the dimensions of the body are known, its viscosity may be calculated from the formula $\mu = 2T/\pi UR^4$, in which μ is the coefficient of viscosity of the substance, T the torque applied, U the relative angular velocity per cm. of length of the cylinder, and R its radius. The apparatus used by the authors consists of a shaft turning freely on anti-friction wheels, with a pulley attached, from which a weight is hung to apply the torque to the cylinder. The latter is supported in a horizontal position, one end fitting into a square socket in the shaft, the other into a fixed socket, and it may be maintained at any desired temperature by surrounding it with a jacket. The rate of rotation of the shaft may be measured by means of a divided circular disc attached thereto. The coefficient of viscosity of bodies such as pitch is found to be a function of the time, the velocity of flow for a given stress diminishing with time from its initial value down to a constant quantity, while on removing the stress there is a flow back in the opposite direction, which gradually diminishes to zero with time. This, it is suggested, may be due to the giving up, on removal of the stress, of elastic energy accumulated during the initial stage when the rate of displacement is relatively great, and preserved intact during the state of steady rotation. That this elastic viscous recovery does not only occur with mixtures was proved by testing cylinders of sodium stearate, when results similar in every respect to those with pitch or glass were obtained. The method gave with shoemaker's wax a result of the same order as that by Stokes's method, in which a steel ball was allowed to sink through the wax, its position being found from time to time by means of the Röntgen rays. The following are the results obtained :—

Substance.	Temperature °C.	Coefficient of Viscosity.
Pitch	0	$5{\cdot}1 \times 10^{11}$
Pitch	8	$9{\cdot}9 \times 10^{10}$
Pitch	15	$1{\cdot}3 \times 10^{10}$
Glass (Soda)	575	$1{\cdot}1 \times 10^{13}$
Glass (Soda)	660	$2{\cdot}3 \times 10^{11}$
Glass (Soda)	710	$4{\cdot}5 \times 10^{10}$
Sodium stearate	8	$5{\cdot}0 \times 10^{11}$
Shoemaker's wax	8	$4{\cdot}7 \times 10^{6}$

W. H. SI.

1244. *Fundamental Equations in the Problem of* N *Bodies.* **P. Pizzetti.** (Accad. Sci. Torino, Atti, 38. 15a. pp. 954–961, 1902–1903.)—The object of this note is to present in a convenient form the equations of energy and of conservation of areas as applied to the problem of n bodies. Examples are worked out, first in which the co-ordinates of the bodies are referred to axes passing through one of their number as origin; second, in which Jacobian co-ordinates are employed, that is, the $n+1$ masses being numbered $m_0, m_1 \ldots m_n$ in any order, m_r is referred to axes passes through the centre of gravity of $m_0, m_1, m_2 \ldots m_{r-1}$, and so on. By this means, if

$$\mu_i = m_0 + m_1 + \ldots + m_i,$$

the kinetic energy is given by $2\mathrm{T} = \sum_{i=1}^{i=n} m_i \frac{\mu_{i-1}}{\mu_i}(\mathrm{X}_i'^2 + \mathrm{Y}_i'^2 + \mathrm{Z}_i'^2)$, and the conservation of areas by $\sum_{i=1}^{i=n} m_i \frac{\mu_{i-1}}{\mu_i}(\mathrm{Y}_i \mathrm{Z}_i' - \mathrm{Z}_i \mathrm{Y}_i') = \text{constant}$, &c., in which X, Y, Z are a certain system of co-ordinates, X′, &c., the corresponding velocities. It is shown how the last given expression for the kinetic energy can be found by the ordinary methods of linear transformation, S. H. B.

1245. *General Theory of the Disturbed Motion of Water in Tubes under Pressure.* **L. Allievi.** (Atti dell' Assoc. Elettr. Ital. 7. pp. 140–196, April–June, 1903. Paper read before the Sezione di Roma, Jan. 30, 1903.)—The author in Chapter I. works out the differential equations of the disturbed motion. The first is the energy equation, which he gives in the form—

$$\frac{w}{g}\left(\frac{dv}{dt}-v\frac{dv}{dx}\right)=\frac{dp}{dx}\text{..........................}(1),$$

in which x is measured along the axis of the tube (a right cylinder), p denotes pressure, v velocity, and ω is the specific gravity of the liquid, g the force of gravity. A second equation is obtained from the difference of two successive sectional layers of the liquid, due to compression of the liquid, and dilatation of the ring of the cylinder surrounding a layer. It has the form $\frac{dv}{dx}=\frac{g}{a^2}\frac{dy}{dt}$ (2), in which y denotes the depth, and $1/a^2=\frac{w}{g}\left(\frac{1}{\epsilon}+\frac{1}{\mathrm{E}}\frac{d}{e}\right)$, ϵ and E denoting modulus of elasticity for the liquid and the material of the tube respectively, d the diameter of the cylinder, e the thickness of its bounding walls. Also $p=wy$, whence (1) becomes $\frac{dv}{dt}-v\frac{dv}{dx}=g\frac{dy}{dx}$. It is found that a represents the velocity of propagation of disturbances. And as this is supposed very great in comparison with v, (1) is used in the form $\frac{dv}{dt}=g\frac{dy}{dx}$ (1a), and we have $\frac{dv}{dx}=\frac{g}{a^2}\frac{dy}{dt}$ (2). These equations admit of integration in the form—

$$y=y_0-f\left(t+\frac{x}{a}\right),\quad v=v_0-\frac{g}{a}f\left(t+\frac{x}{a}\right),$$

f being an arbitrary function. It is shown that a has the dimensions of a velocity, and numerical values are given for it according to the material of which the tube is composed. Having thus worked out the general theory, the writer in Chapter II. treats of the special case of the simple ram. It is a tube of indefinite length, having at its extremity (the origin) an orifice (bocca) controlled by a valve or interceptor (intercettatore). The equations used are here $y=y_0+\mathrm{F}\left(t-\frac{x}{a}\right)$, $v=v_0-\frac{g}{a}\mathrm{F}\left(t-\frac{x}{a}\right)$, F denoting the arbitrary function. In Chapter III. he considers the counterstroke of the ram in a tube of definite length l, using the equations $y=y_0+\mathrm{F}-f$, $v=v_0-\frac{g}{a}(\mathrm{F}+f)$. The cases dealt with in Chapters II. and III. are summarised as follows: (1) Phases of the simple ram during the motion of the interceptor. (2) Phases of the counterstroke during the motion of the interceptor. (3) Phases of the counterstroke after the arrest of the interceptor. In Chapter IV. the author discusses various applications of the theory, including the use of air chambers.

S. H. B.

1246. *Motion of a Solid in a Gaseous Medium.* **L. Jacob.** (Comptes Rendus, 136. pp. 1386–1388, June 8, 1903.)—This refers to a previous note, in which the writer considered the motion of a solid of revolution in the direction of its axis through a gas, the speed being greater than A_0, the velocity of sound in the medium in its normal state. [See Abstract No. 1153 (1903).] It was there shown that this motion causes a discontinuity affecting the velocities and pressures, and moving at the same speed with the solid. The law of transformation was given by Hugoniot, namely—

$$P/P_0 = \left(\frac{n+1}{n-1}\frac{\rho}{\rho_0} - 1\right) \Big/ \left(\frac{n+1}{n-1} - \frac{\rho}{\rho_0}\right).$$

On either side of the discontinuity the gas obeys the ordinary adiabatic law. For velocities less than A_0 the pressure at the summit of the projectile is the pressure resulting from adiabatic compression from the normal state. For velocities greater than A_0 it is the pressure resulting from adiabatic compression from an initial state determined by the discontinuity. Numerical tables are given in illustration. A further example is given of a projectile in the form of a very elongated cylinder, but with conical point like a shell. He finds that for values of velocity V less than A_0, V is constant throughout the fluid, but for values greater than A_0 the velocity is minimum at the point of contact with the solid. This, again, is illustrated by numerical tables. He concludes with the statement that for velocities greater than A_0 a certain part of the fluid in the neighbourhood of the solid is carried along with the solid.
S. H. B.

1247. *Transverse Vibrations of a Lamina which depend on Two Parameters only.* **G. Bisconcini.** (Accad. Lincei, Atti, 12. pp. 385–389, May 17, 1903.) —This paper is founded on one by Levi-Civita ("Types of Potential which can be made to depend on two Parameters only," Accad. Sci. Torino, s. II., tome 49, 1899). Given $\Delta w = \frac{d^2w}{dx^2} + \frac{d^2w}{dy^2} - \frac{d^2w}{dt^2}$ (which is the same thing as $\Delta w = \frac{d^2w}{dx^2} + \frac{d^2w}{dy^2} + \frac{d^2w}{dz^2}$, with $z = t\sqrt{-1}$), the writer proposes to find three independent functions, ρ_1, ρ_2, ρ_3 of x, y, t, which shall have the following property, namely: If ρ_1, ρ_2, ρ_3 be substituted for x, y, t in the above equation, and $\frac{dw}{d\rho_3}$ assumed to be zero, the resulting equation shall not contain ρ_3. The function w is then a function of the two parameters ρ_1 and ρ_2 only. And the equation $\Delta w = 0$ in this form expresses the transverse vibrations of a lamina in a certain defined case. The equation obtained is $\frac{d^2w}{d\rho_1^2} + \frac{2}{\rho_2}\frac{dw}{d\rho_2} = 0$, the general integral of which is $w = \psi(\rho_1) + (1/\rho_2)\chi(\rho_1)$, ρ_1 and ρ_2 satisfying the conditions $x\cos\rho_1 + y\sin\rho_1 - \phi/\rho_1 = t$, $\rho_2 + x\sin\rho_2 - y\cos\rho_1 + \frac{d}{d\rho_1}\phi(\rho_1) = 0$; ϕ, χ, ψ being arbitrary functions.
S. H. B.

1248. *Permanent Modifications of the Properties of Systems affected with both Hysteresis and Viscosity.* **P. Duhem.** (Comptes Rendus, 138. pp. 942–945, April 18, 1904.)—Brillouin enunciated in 1888 the hypothesis that many modifications, in appearance spontaneous, which take place without variation of temperature or of external conditions, are really due to an accumulation of permanent changes produced by numerous small oscillations of temperature and external conditions. This hypothesis, says the author, has been confirmed by the researches of Marchis and Chevallier on hysteresis, but no confirmation has yet been obtained of the influence of the supposed small oscillations in the external conditions. This can be made apparent, he says, by regarding the general laws of hysteresis investigated by Kelvin, Tait, Rayleigh, and von Helmholtz. The principle, according to these writers, is a completion of d'Alembert's principle, namely, that we deduce the equations of motion of a system from its equations of equilibrium by adding to the action of external conditions the action of inertia and viscosity corresponding to the same variable. A train of reasoning is given concerning a body defined by a single normal variable x and its velocity of transformation x'. The external or observed action is represented by X, and x is supposed not to possess inertia. The coefficient of viscosity is proportional to x', say $\nu(x')$. If X oscillates between A_0 and A, x' may, or may not, and he supposes that it does, maintain the same sign. He compares two cases, in one of which X oscillates, and the velocity of transformation is denoted by x'; in the other X retains the constant value X_0, and the velocity is y'. He finds that $\nu(x'-y')=X-X_0$, whence if ν is great, and $X-X_0$ small, $x'-y'$ is small. This result he gives in the theorem: "So long as the velocity of transformation retains the same sign, small oscillations in the observed action X about a mean constant value exert only feeble influence on the modifications of a system having hysteresis and viscosity, provided that the coefficient of viscosity is very great compared with the oscillations of the observable action X." S. H. B.

1249. *Elastic Equilibrium of an Indefinite Circular Cylinder.* **O. Tedone.** (Accad. Lincei, Atti, 13. pp. 232–240, March 6, 1904.)—The writer has in a former memoir (Annals of Mathematics, tom. VIII., ser. III., p. 129 *et seq.*) discussed the general problem of finding the displacements u, v, w and the dilatation θ in the interior of an elastic body in equilibrium where (1) the displacements, (2) the tensions, are given at each point of the bounding surface σ. In the present paper he gives results for the special case in which the elastic body is a right cylinder of indefinite length. The fundamental equations are of the following form—

$$u=\frac{1}{4\pi}\int_\sigma u\frac{d\mathrm{G}}{dn}d\sigma-\frac{\lambda+\mu}{2\mu}x\theta+\frac{\lambda+\mu}{8\pi\mu}\int_\sigma \xi\theta\frac{d\mathrm{G}}{dn}d\sigma,$$

with two corresponding equations for v and w. In these equations G denotes Green's function—*i.e.*, a harmonic function which has assigned values on the surface σ—n is the normal to σ measured towards the interior, λ and μ are Lamé's constants, and ξ, η, ζ the co-ordinates of a point on σ. It is impossible in an abstract to give the mathematical work. The solution obtained for the case in which u, v, w are given on σ is unique. Subsequently a solution is found for the case in which the tensions instead of the displacements are given on σ. S. H. B.

1250. *Problems of the Atmosphere.* **J. Dewar.** (Roy. Inst., Proc. 17. 1. pp. 223–230, Nov. 1903.)—If the earth's surface were cooled to −200°, an ocean of liquid air, 35 ft. in depth, would be formed. Liquid air contains 1/50000 of its volume of uncondensable gases, and water holds about as much air in solution. An apparatus is described by means of which helium, hydrogen, and neon can be separated from air without the use of liquid hydrogen. The He and Ne collected in this way made 1/58000 of the air volume which would contain as a minimum 1/362000 of Ne, 1/70000 of He, and not more than 1/100000 of H (Gautier's estimate for H is 1/5000, Rayleigh's 1/30000 max.). Under electric discharges these volatile gases give a bright orange glow, especially at the negative pole, and lines in the red, orange, and yellow, ascribed to those three gases, and other lines in the rest of the spectrum, mostly of uncertain origin. Many lines seem to agree with the coronal and auroral spectrum, some with the nebular spectrum; according to H. Stassano, many auroral lines on the ultra-violet side would agree with lines which Liveing and Dewar found in the highly volatile gases mentioned, and in argon, krypton, and xenon. The rosy tint of aurora streamers seems to be due to neon. Referring to the diagrams of the constitution of the atmosphere of Ferrel and of Hinrich, the author points out that, above an altitude of 56 miles, the atmosphere should substantially consist of hydrogen. A sample of air, taken at an elevation of 9 miles, did not differ in composition from the surface air, however; but clouds have been observed at heights of 17 miles, showing that the intermingling extends into high strata. H. B.

1251. *Circulation of the Atmospheres of the Sun and Earth.* **F. H. Bigelow.** (Monthly Weather Rev. 32. pp. 15–20, Jan., 1904.)—Having shown that the canal theory of Ferrel and of Oberbeck, which Hildebrandsson also rejects, does not conform to the cloud motions over the U.S. [see Abstract No. 587 (1903)], the author deduces the foundations for a new theoretical meteorology. Starting from Bernouilli's theorem and referring to the line integrals in the atmosphere of Bjerknes and Sandström, he arrives at equations, partly covered by Helmholtz and Emden, for the slope of the curve which separates the two stratified currents flowing past each other. In case I., applicable to the temperate and polar zones (with eastward relative velocities), the curve continually rises above the successive tangents to the horizon and approaches the axis of rotation in the direction of the celestial pole. In case II., applicable to the tropical zones (westward drifts), the curve falls below the horizon and approaches the axis. In case III., applicable to the Sun, Jupiter, and Saturn, the curve rises but recedes from the axis of rotation. These general conditions are greatly modified because the air does not rotate in unbroken rings, because waves and vortices are engendered between discontinuous strata, by cyclones and vertical convection currents, and because case I. and case II. intrude into one another. H. B.

1252. *Hertz Rays from the Sun and Auroræ Boreales.* **C. Nordmann.** (Soc. Franç. Phys., Séances, 3. pp. 184–220, 1903.) *Diurnal Period of Auroræ.* **C. Nordmann.** (Comptes Rendus, 136. pp. 1430–1432, June 15, 1903.)—The author sums up the facts known concerning the auroræ, and criticises the hypothesis of Arrhenius and of Birkeland. If the sun sends out (Arrhenius) very small particles, negatively charged, repelled by the pressure of light, and discharged by ultra-violet rays, this discharge ought to take place near the sun and no charged particles could reach us; the periodicity of auroræ would, moreover, be against Arrhenius. Birkeland suggests that kathode rays, emanated by the sun, produce currents in the upper atmosphere, fairly parallel to the earth, under the action of the magnetic field of the earth. In that case the sun's rotation should affect the magnetic elements (disproved by Schuster), and every aurora should cause a magnetic storm. According to the author, the sun emits Hertz rays [see Abstract No. 715 (1904)], which produce kathode rays in the direction of the magnetic lines of force, approximately vertical near the pole. As these rays travel by preference from lower to higher potential, and as their luminosity is stronger in the less rarefied strata, the auroræ appear radial and abruptly cut off below, since the earth electric field stops their propagation. That auroræ are more frequent and intense in higher latitudes is because the Hertz rays remain there effective for a longer time after sunset, and have to traverse a comparatively thinner layer of the atmosphere to arrive in a stratum of suitable density. The reduction of the Hertz rays by atmospheric absorption would, calculated for the same height above sea-level, be 1/100 in latitude 47° and 1/5000 in latitude 70°. Temperature conditions also favour polar auroræ. But owing to ionisation, and because the magnetic pole does not coincide with the geographical pole, the zone of greatest auroræ frequency is between the two poles. The altitude of the auroræ decreases with increasing latitude; the spectrum is that of the kathode glow. The diurnal period is much influenced by the strong diffraction of Hertz rays (of large wave-length), and by the degree of ionisation. If the sunlight were alone to be considered, auroræ should be conspicuous about sunset and sunrise; but owing to ionisation and recombination of the ions (Langevin), the frequency diminishes steadily during the night, and the frequency maximum falls later in the evening as we approach the pole. The real maximum should fall soon after noon. The annual period has been explained in Abstract No. 1705 (1902), for medium latitudes; above latitude 72° the auroræ are most common about the winter solstice—but the author says little on that point. Disturbances of the magnetic needle are to be expected only when the aurora is accompanied by rapid movements in the atmosphere. Strong solar activity produces auroræ all over the earth. H. B.

1253. *Errors of Hansen-Newcomb Moon Tables for* 1895–1902. **E. F. van de Sande Bakhuyzen.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 370–387 and 412–426, Jan. 21, 1904. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, Dec. 19, 1903.)—The author has made a new investigation into the errors of the present tables of the moon's motion, following the same method as that employed by Newcomb in 1876. Detailed descriptions of the various processes are given, and reference made to two tables embodying the revised corrections found therefrom; the formulæ in which the corrections are applied are also given. In the later paper the author mentions that he was induced to reconsider his method after reading the article by P. H. Cowell in the *Observatory* for Sept., 1903, and then decided that there were still two inequalities of nearly monthly periods which should be taken into consideration in the computation of the corrections, the first depending on the mean longitudes of Venus, the Earth, and Jupiter, the other on the figure of the Earth. He then proceeds to introduce these terms in the analysis previously formulated, and gives the resulting modified corrections. C. P. B.

1254. *Stellar Revolutions within the Galaxy.* **F. W. Very.** (Amer. Journ. Sci. 16. pp. 127–138, Aug., 1903.)—The paper deals with an attempt to roughly determine the dimensions of the system of stars constituting the Galaxy. By various preliminary assumptions of the masses involved, approximate mean velocities of these, moving under the combined attraction of each other, may be deduced and compared with observation. If we can then independently obtain a measure of the parallax of any constituent body of the galactic streams, a further check on the determination is given. As there is considerable evidence that all new stars have been intimately associated with the Milky Way, the observations of Nova Persei, which were obtained in 1901, are examined in order to determine its parallax. Most of the measures lead to a consistent conclusion that the parallax is less than 0″·1, and this would indicate a velocity of expansion for the surrounding nebula closely approximating to that of light. From a discussion of the measures of Perrine and Ritchey, the most probable value of the parallax of Nova Persei would appear to be 0″·05, and, inferentially, this may be regarded as the parallax of the region of the Milky Way in the immediate vicinity of the Nova. The author next proceeds to discuss the bearing of Kapteyn's work on the scheme of distribution of the stars of various types constituting the Milky Way. The structure is regarded as either spiral or annular in its major stream, and as a leading feature it may be assumed as being uniplanar. This complete system, however, is undoubtedly subdivided into countless secondary streams, whose interlacing movements form a common envelope to the more condensed portions, probably of more or less spheroidal forms. On such an aggregation of matter the author discusses the probable effects of two opposite forces—(1) movements of approach, due to gravitational attraction, and (2) movements of dispersal, due possibly to some modification of explosive force—the limits in each case being determined by the dimensions of the constituent bodies. C. P. B.

1255. *Sun-spot Variation in Latitude.* **W. J. S. Lockyer.** (Roy. Soc., Proc. 73. pp. 142-152, March 7, 1904.)—To watch the drift of solar prominences, latitude zones of 10° are sufficient, but for the sun-spots the author finds that zones of 3° should be studied. Examining the tables of sun-spot areas, published by the Astronomer Royal for each degree, for the period 1874 to 1902, and Spörer's observations since 1861, the author detects distinct sun-spot activity tracks—possibly related to Köppen's cyclone Zugstrassen—which first become more prominent and then gradually fade away while approaching the equator more and more; subsequent tracks appear at higher latitudes. When the mean heliographic latitude of spotted area is plotted for each hemisphere, the curves begin at high latitudes, generally about sun-spot minimum, and are decidedly wavy. This was noticed by Spörer and by C. Braun, but the author points out that Spörer's curves are the integrated results of several activity tracks, and that the wavy nature of the integrated curve is real. Spots may burst out in high latitudes even up to the time of sun-spot maximum. There are corresponding prominence-activity tracks.
H. B.

1256. *Sun-spot Frequency and Terrestrial Magnetism.* **C. Chree.** (Roy. Soc., Proc. 73. pp. 198-201, March 23, 1904. Abstract.)—The author investigates what differences may exist between the sun-spot connection on ordinary days and on magnetically quiet days, and what differences arise when the formula $R = a + bS$ [see Abstracts Nos. 1253 (1903), and 862 (1904)] is applied to the mean of the differences between the absolutely extreme daily readings instead of to the range of the mean diurnal inequality. The paper deals with data from Milan (1836-1901), Greenwich (1841-1896), Pawlowsk and Katharinenburg (1890-1900), Batavia (1887-1898), and Mauritius (1875-1890). The Greenwich observations suggest a slight progressive increase in b/a during the last sixty years as to declination and horizontal force, which does not hold for Milan. At Pawlowsk, where disturbances, especially of the vertical force, are prominent, the differences between the results for all days and for quiet days are very large. The formula becomes less applicable the more disturbed the respective magnetic quantity is. The year 1893 was a year of absolute sun-spot maximum, but much less disturbed than 1902 in all the stations. H. B.

REFERENCES.

1257. *Application of Nickel Steel to Chronometry.* **C. E. Guillaume.** (Soc. Franç. Phys., Séances, 3. pp. 253–261, 1903.)—The author deals with the use of the non-expansive alloy (Invar) for pendulums, clock-springs, and compensated balances for chronometers.

1258. *Oscillating Table for Moments of Inertia.* **W. H. Derriman.** (Phil. Mag. 5. pp. 648–650, June, 1903. Physical Society, Jan. 23, 1903.)—A description of an oscillating table for determining moments of inertia experimentally and for illustrating the laws of the subject. J. W. P.

1259. *Estimation of Internal Friction of Solids.* **M. Segel.** (Phys. Zeitschr. 4. pp. 493–494, June 15, 1903. Physik. Lab. des Polytechnischen Instituts, Riga.)—A theoretical and mathematical consideration. J. W. P.

1260. *Experimental Laws of Friction.* **H. Chaumat.** (Comptes Rendus, 136. pp. 1634–1637, June 29, 1903.)—The author gives first a mathematical treatment and then describes experiments by which he proves that the ratio of tangential component to normal component of the whole action diminishes when the disc experimented upon has its geometrical centre removed from its centre of gravity, roughness and speed remaining the same. J. W. P.

1261. *Effect of Momentary Relief of Great Pressure.* **J. Y. Buchanan.** (Roy. Soc., Proc. 72. pp. 88–92, July 31, 1903.)—The effect was first illustrated in the thermometers with protecting case used for deep-sea temperatures on the *Challenger.* Recent experiments with perforated copper spheres containing glass bulbs are here described. When the glass bulb fractures, the resilience of the water in the sphere partly counteracts the external pressure, and curious deformations are produced. J. W. P.

1262. *Evaporation of Water in a Current of Air.* **E. P. Perman.** (Roy. Soc., Proc. 72. pp. 72–83, July 31, 1903.)—An experimental treatment, in which the following points are established: (1) When air is aspirated through water it becomes saturated with great rapidity; (2) the pressure of the aqueous vapour in the saturated air is the same as the vapour pressure of water when no other gas is present; (3) the density of the aqueous vapour in the mixture is normal; (4) the density of saturated aqueous vapour (without admixture) is probably only very slightly (if at all) above normal at temperatures up to 90°. J. W. P.

1263. *Metrical System of Weights and Measures.* **A. Siemens.** (Nature, 69. p. 157, Dec. 17, 1903. Abstract of paper read before the Royal Statistical Society, Dec. 15, 1903.)—The present metrical system is considered by the author to be the result of the agitation by J. Watt in 1783. Its general adoption is advocated. G. W. de T.

1264. *Lecture Apparatus.* **E. Rupp.** (Zeitschr. Anorg. Chem. 38. 1. pp. 107–109, Jan. 2, 1904.)—Description of a glass model of a Bunsen burner with an arrangement for blowing a fine spray of any desired saline solution upwards into the interior of the flame. Also a convenient arrangement for filling several cylinders over the same trough with the same gas. A. D.

1265. *National Physical Laboratory.* (Engineering, 77. pp. 415–417, March 25, 1904.)—This account of the annual reception of visitors at the National Physical Laboratory also contains an abstract of the Annual Report for 1903. J. B. H.

1266. *Hyperbolograph.* **E. Estanave.** (Journ. de Physique, 3. pp. 134–137, Feb., 1904.)—A device consisting of a prismatic tank containing liquid, whirled so as to form hyperbolic surfaces which correspond to the sides of the tank considered as asymptotes thereto. The form of the curve is recorded, say, by using a solution of mercury and making this act upon copper plates. A. D.

1267. *Thermal Relations of Floating Clouds.* **W. N. Shaw.** (Monthly Weather Rev. 31. pp. 266–268, June, 1903. Reprinted from Quarterly Journal of the Royal Meteorological Society, pp. 95–100, 1902.)—Notes on the saying, "La lune mange les unages," and the apparent paradoxes that a cloud may vanish while losing heat by radiation, and may become thicker while receiving heat. The author explains the phenomena with the aid of a Hertz diagram of thermal lines for moist air, and describes a simple demonstration. A glass globe is filled with moist air, which can electrically be heated, and provided below with a tubular projection, dipping into a mercury cistern which is placed on a balance beam in unstable equilibrium. Heating the air first causes increase of pressure in the globe, and then, by upsetting the balance, considerable expansion and condensation. H. B.

1268. *Cinematography of Barometric Movements.* **P. Garrigou-Lagrange.** (Comptes Rendus, 136. pp. 1413–1415, June 8, 1903.)—Studying the daily weather charts for Europe and also America for the period November, 1902, to April, 1903, by cinematographic methods, the author finds that the general atmospheric movements can be reduced to two currents, an oscillation from right to left or from left to right according as the west-east current is opened at the north side and blocked on the south, or *vice versâ.* The period is in America about 7 or 8 days, in Europe not more than 10 or 12 days. H. B

1269. *Barometric Forecasts.* **G. Guilbert.** (Comptes Rendus, 136. pp. 1443–1444, June 15, 1903.)—Although the barometric gradient is not proportional to the strength of the wind, one may say that a normal barometer gradient of from 1 to 4 mm. per geographical degree corresponds to a wind force increasing from feeble to violent. An abnormally strong (weak) wind generally brings a high (low) barometer within 24 hours, while normal winds have no such effect. H. B.

1270. *Barometric Formula of Laplace.* **L. Maillard.** (Comptes Rendus, 136. pp. 1427–1430, June 15, 1903.)—Balloon observations at Trappes show that the formula of Laplace for the altitude difference between two places in kilometres $Z = 18{\cdot}336(1 + \alpha\tau) \log (h_1/h_2)$, where $\alpha = 0{\cdot}004$ and τ the mean between the temperatures of the two stations, is not reliable; at an altitude of 13,500 m. the discrepancy amounted to 1,128 m. Halley's formula $Z = C \log (h_1/h_2)$ would be preferable, h_1 and h_2 being the mean normal pressures, and probably $C = c(1 - \beta\tau)$. Ramsay's observation that the crypton line remains visible at a pressure of 0·000035 mm. would be valuable for these investigations. H. B.

1271. *Physical Constitution of the Atmosphere.* **L. Maillard.** (Comptes Rendus, 136. pp. 1546–1548, June 22, 1903.)—If the known rate of temperature decrease continued at higher altitudes, we should have absolute zero temperature at 38 km. But we want further balloon work and laboratory researches on the properties of air at low pressures and low temperatures. The density of the atmosphere should decrease up to altitudes of 30 or 50 km., and then increase to 0·21 at an altitude of 75 km., afterwards to decrease steadily; the inversion gives rise to vertical currents. The author briefly refers to the length of the dawn, the assumed height of the Krakatoa dust, of krypton and of shooting stars, and to the colour of the atmosphere, as bearing upon this question. H. B.

1272. *Scientific Kite-flying.* **W. H. Dines.** (Nature, 68. pp. 154–155, June 18, 1903.)—Refers to the experiments made in July and August, 1902, from a steam tug, mentioned in Abstract No. 389 (1903). More than two kites could rarely be attached to the wire owing to the different wind velocities at different altitudes. The temperature on Ben Nevis, 60 miles to the south-west, was often found from 5 to 8° F. colder than at the same level in free air. H. B.

1273. *The Solar Constant.* **G. B. Rizzo.** (Accad. Sci. Torino, Atti, 38. 13a. pp. 392–408, 1902–1903.)—Critical discussion of the various interpolation formulæ used for expressing the intensity of solar radiation in terms of the altitude of the sun above the horizon, none of which are satisfactory. The author reaches a formula for the solar constant referred to the zenith at different heights above sea-level: Q (in small calories per sq. cm. per min.) $= 1{\cdot}324 + 1{\cdot}268(1 - a)^{\frac{1}{2}}$, where a is P/760, P being the atmospheric pressure in mm. The author gives more weight to Continental observations than to those made at marine stations, such as Teneriffe, on account of the disturbing influence of saline particles at the latter. A. D.

1274. *Solar Radiation at Providence, R.I.* **H. N. Davis.** (Monthly Weather Rev. 31. pp. 275–280, June, 1903.)—Arrangements for observations with an Ångström pyrheliometer were made by C. Abbe and C. Barus, and observations taken in 1901 and 1902 by the author and by R. Pierce, Jr.; temperature, air pressure, and humidity were also determined. The author tabulates the data and discusses the instrumental errors. H. B.

1275. *Kite-flying in the Tropics.* **O. L. Fassig.** (Monthly Weather Rev. 31. pp. 582–587, Dec., 1903.)—In June, 1903, the Geographical Society of Baltimore sent out the schooner *W. H. van Name* to the Bahamas with a staff of 25 scientists of various branches, the outfit comprising two box kites with nephoscope, Richard barograph, &c. Full data of the ascents are given, and the temperature, humidity, and pressure curves reproduced. The pressure decrease was fairly steadily 0·1 in. per 100 ft. up to the 4,000 ft. reached; the temperature decrease was first 1° for 100 ft., and at the higher level 1° for 196 ft. The kite was also flown from a steamer. The wind seemed to fall off above 4,000 ft. H. B.

1276. *Detailed Cloud Observations.* **F. L. Odenbach.** (Monthly Weather Rev. 31. pp. 573–576, Dec., 1903.)—The author insists on cloud observations, and proposes a detailed classification. Thunder-clouds, *e.g.*, are often said to show at the top a beak (front) and a spur (rear), and below a ram and a rudder. H. B.

1277. *Measuring Tides and Currents at Sea.* **R. A. Harris.** (Science, 19. pp. 704–707, April 29, 1904.)—The author suggests a novel method of using a piano-wire sounding apparatus. The wire is attached to a heavy weight, which is sunk and not to be recovered. Observations are to be made from a boat with the wire drawn taut, verticality of the wire being determined with the aid of a plumb-line or a telescope and mirror, hung in gimbals. He gives formulæ for the errors which want of verticality of the wire in its upper or lower portions, the current, weight of the wire, &c., would cause, not with the object of supplying corrections, but for the purpose of ascertaining the conditions of applicability of the method. He has experimented on the force of the water impulse on steel rods of from 0·036 to 0·5 in. in diameter d, the water velocity v varying between 1 and 1·5 ft. per sec., and finds the value $\zeta\gamma l d v^2/2g$ for this force, l being the length of the wire, γ the weight of the unit of water at the temperature of the stream, and $\zeta = 0{\cdot}95$, *i.e.*, about half of the value of Du Buat and Thibault, 1·86, for the case of a plane perpendicular to the flow of the stream. H. B.

1278. *Ascension of Closed Rubber Balloons.* **H. Hergesell.** (Monthly Weather Rev. 31. pp. 571–573, Dec., 1903. Translated from Illustrirte Aeronautische Mittheilungen, May, 1903.)—Assmann's inflated closed rubber balloons rise until they burst; the instruments are suspended from a parachute, or from smaller, less inflated balloons. The author examines the conditions of ascension, pressure, temperature, velocity, elasticity of the envelope, &c. The height to which the balloons rise depends only on the capacity of the rubber to expand. If they can expand to twice their original diameter, heights of 24,000 m. may be reached; should holes develop, the balloons will still go up to 12,000 m.; in that case, however, they will not continue to rise, but float, so that the thermometers do not get proper aspiration. H. B.

1279. *New Nephoscope.* **L. Besson.** (Monthly Weather Rev. 32. pp. 13–14, Jan., 1904. Translated from Annuaire de la Société Météorologique de France, Feb., 1903.)—In order to avoid the error due to the vertical component on the movement of clouds [see Abstract No. 968 (1903)], the author observes the direction and relative velocity near the zenith. On a pedestal is fixed a wooden disk, divided into degrees, carrying in the centre an inclined mirror. It is surrounded by a nickel ring, which supports a circular frame; these parts can be turned; on the frame are stretched two orthogonal systems of parallel threads. The apparatus is more convenient than the dark-room nephoscope, and has been tried at Paris. H. B.

1280. *Condensation Nuclei.* **C. T. R. Wilson.** (Roy. Inst., Proc. pp. 1–5, Feb. 19, 1904.)—Abstract of a lecture illustrated by experiments on the action of nuclei in causing fog and rain-like condensation in air. Amongst the experiments shown was condensation in the form of drops or fog in dust-free air when the moist air was exposed to Röntgen rays and to the radiation from radium, afterwards being allowed to expand. Here the condensation nuclei were the ions produced in the air by the rays. J. J. S.

1281. *Dispersal of Hail-clouds.* **C. Marangoni.** (Rivista Sci.-Industriale, 36. pp. 25–31, Feb. 29, 1904.)—Account of successful experiments in Italy with large conical cannon in which acetylene-air mixture is exploded. A. D.

1282. *Photogrammetry in Hydrography.* **A. Le Mée.** (Revue Scientif. 1. pp. 330–338, March 12, 1904.)—Shows how to use snapshot photographs containing the sea-horizon for mapping out coastlines and other details. A. D.

1283. *Yield of a Spring Fed by Infiltration in Times of Drought.* **J. Boussinesq.** (Comptes Rendus, 136. pp. 1511–1517, June 22; 137. pp. 5–11, July 6; pp. 101–106, July 13 and pp. 153–158, July 20, 1903.)—The author assumes an impermeable stratum, slightly inclined, on which a permeable layer is superposed, whose lower layers are charged with water under atmospheric pressure, and deduces the laws for the flow of the water, first in general, and then for the case that the strata are cut off on one side. He arrives at formulæ for the yield of a spring in times of drought. The deductions are strictly mathematical; exemplifications are not added. H. B.

1284. *The Two Great Circles of Seismic Instability.* **de Montessus de Ballore.** (Comptes Rendus, 136. pp. 1707–1709, June 29, 1903.)—The author considers that the epicentres of the 156,878 large seismic disturbances known to him are distributed along two great circles, or within 15° of them, namely, 64,426 on the Pacific circle (Andes, Japan, Malay; pole 35° 40′ N. and 20° 40′ E.) and 84,023 on the Mediterranean circle (Alps, Caucasus, Himalaya, New Zealand; pole 40° 45′ N. and 152° 30′ E.). These two circles intersect under an angle of 67° 5′. There are three unstable regions outside these belts, about the Baikal Lake, Kashgar, and Wei Ho, together with only 8,429 disturbances. That we know of more earthquakes on the Mediterranean circle may simply be due to our better knowledge of those regions. H. B.

1285. *Figure of the Earth from Pendulum Observations.* **G. L. Hosmer.** (Technology Quarterly, 16. pp. 60–63, June, 1903.)—The Massachusetts Institute of Technology sent, in 1896, an expedition to Greenland, and in 1901 one to Sumatra. According to the observations taken with half-second invariable pendulums by G. R. Putnam at four spots in 1896, and by Hosmer at two places in 1901, and the observations by both at the reference station, Washington, D.C.—all these stations being approximately on the same meridian—Clairaut's formula for the flattening of the poles would yield the value 1/292·06. H. B.

1286. *Variations of Gravity.* **C. Aimonetti.** (Accad. Sci. Torino, Atti, 38. 9a. pp. 241–261, 1902–1903. Geodetic Cabinet, Univ. Turin.)—Reduction of observations showing the variations throughout Piedmont, with anomalies ranging from $+0·53$ to $-0·66$ cm./sec.^{2}. A. D.

1287. *Variations of Gravity.* **A. Riccò.** (N. Cimento, 6. pp. 297–342, Nov. and Dec., 1903.)—Reduction of observations in eastern Sicily, Aeolia, and Calabria with a view to tracing a connection, if any, between anomalies of gravity and volcanic distribution. Historical *résumé.* Maps of the isanomalous lines, which indicate excess distributions of matter, particularly out at sea, equivalent to 1½-km. thickness of the earth's crust. The isanomalous lines run roughly parallel to the Italian and Sicilian coast, and are deflected by some of the volcanic centres, but on the whole these centres act as ordinary mountains. The pressure which has forced up the mainland appears to have compressed the submarine rocks and to be still operative in producing earthquakes and volcanic phenomena. A. D.

1288. *Harmonics in Seismic Vibrations.* **E. Oddone.** (Accad. Lincei, Atti, 13. pp. 92–96, Jan. 17, 1904.)—The theory of harmonics in vibrations of solids led to an investigation as to the presence of harmonics in seismic disturbances. Results confirmatory. A. D.

1289. *Seismic Shocks in Portugal in* 1903. **P. Choffat.** (Comptes Rendus, 138. pp. 313–315, Feb. 1, 1904.)—Small earthquakes are frequent in Portugal. Strong shocks were felt on August 9 and September 14, on the former day all over Portugal and in south-western Spain. The zones of equal intensity embrace rocks of all kinds, but an influence of the orographic character can be traced. The principal centres were in both cases in the ocean, in the latitudes of Arrabida and of Lisbon; but there is also a principal centre in Andalusia, which seems to act independently of the others or alternating with them. H. B.

1290. *Seiches in the Madü-See, Pomerania.* **W. Halbfass.** (Archives des Sciences, 17. pp. 281–289, March, 1904.)—The lake, situated near Stargard, has a length of 15·5 km., a width of 3 km., and a maximum depth of 42 m., and forms a regular basin with flat banks. The formula of Du Boys gives for the uninodal oscillation a period of 36·3 min.; the mean of the very concordant observations with Sarasin limnographs is 35·5; a series of regular seiches continued from January 7 to 12, 1902. The binodal seiche has a period of 20·1 min. The ratio of the two periods is thus 1·77; for the lakes of Geneva and Neuchâtel it is 2·06, for Lake Thun 2·00, elsewhere less than 2. Periods of 14·6, 8·4, 5·3 min. were also observed. H. B.

1291. *Earthquake in the Balkans, April* 4, 1904. **T. Moureaux.** (Comptes Rendus, 138. pp. 897–898, April 11, 1904.)—The author mentions that though feeble shocks were noticed at Sofia and Belgrade, at Philippopolis they were the most severe felt for 50 years. The first severe shock was followed by one of the same intensity 5 min. afterwards.

1292. *Distribution of Chemical Elements on the Earth, and Atomic Weights.* **L. de Launay.** (Comptes Rendus, 138. pp. 712–714, March 14, 1904.)—From geological and chemical considerations, not explained in the paper, the author concludes that at the time when the earth was in a fluid condition the protuberances and atmosphere consisted, starting from above, of H, then N and O ; the earth of compounds of Si, Al, alkalies and alkaline earths ; Cl, S, P ; iron group, Ti, Vd ; Cu ; Zn, Pb, Sb, Ag, Hg, Bi, W, Au, Ur, Ra. This is the order of increasing atomic weights. H. B.

1293. *Earthquakes in Roumania and Bessarabia.* **F. de Montessus de Ballore.** (Comptes Rendus, 138. pp. 830–832, March 28, 1904.)—From the statistics collected since 1592 by Hepites, director of the Roumanian Meteorological Department, the author concludes that, about the sharp angle which the Carpathians make in the south-east, the epicentres are grouped along the line Kischinew–Bucharest, and not, as Martonne had suggested, the line Galatz–Buzen. The former line has the direction N.E.-S.W., and is thus parallel to the Erzgebirge and several other seismic lines. The epicentres of earthquakes which used to disturb the coast of the Black Sea between Odessa and the mouth of the Danube seemed to lie in the Black Sea where the isobathic line of 100 m. falls along the direction Bourgas–Eupatoria (Crimea), and the isobathic line of 2,000 m. is parallel to it. H. B.

1294. *Longitude Determination by Chronometer Transport.* **P. Ditisheim.** (Comptes Rendus, 138. pp. 1027–1030, April 25, 1904.)—Five chronometers, of the type used on small French vessels, were several times transported by rail from Neuchâtel to Paris and back, being suspended in their double boxes by rubber tubes from the nets in the carriages. The mean difference in longitude observed, 18 min. 28·80 sec., is probably correct within 0·1 sec. H. B.

1295. *Nova Geminorum before its Discovery.* **E. C. Pickering.** (Astrophys. Journ. 17. pp. 305–308, May, 1903. Harvard College Observatory Circular, No. 70.) —An account of some photographs taken of the region around the Nova during 1903. The first plate upon which it can be detected is one taken on March 6, when it appears as an object of the magnitude 5·08. Its gradual decrease in magnitude during the month is shown by a table. On March 25 it appears on a photograph taken with an objective prism, and the spectrum shows the hydrogen and helium lines, but no trace of the line $\lambda = 5003$, which, however, appeared upon photographs taken on March 29, 31, and April 1. E. C. C. B.

1296. *South Polar Cap of Mars.* **E. E. Barnard.** (Astrophys. Journ. 17. pp. 249–257, May, 1903.)—Observations taken at Lick Observatory with the 12- and 36-in. refractors during 1892 and 1894 respectively. The series of measurements show that the diameter of the S. polar cap underwent identical changes in the two corresponding periods leading up to the summer solstice, and the results are plotted in two curves. The cap, presumed to be of snow, continues to diminish after the summer solstice. The presence of an atmosphere is indicated. A yearly recurrence of a projection at the edge of the cap is attributed to a range of mountains. H. F. H.

1297. *Eight Stars whose Radial Velocities Vary.* **E. B. Frost** and **W. S. Adams.** (Astrophys. Journ. 19. pp. 151–155, March, 1904.)—The stars observed were *g* Persei, ϵ Persei, θ' Orionis, θ^2 Orionis, σ Orionis, ξ Orionis, S Monocerotis, and η Hydræ. Variations up to 60 km. per sec. in velocity were measured, but in most cases the results are not considered very reliable owing to the diffuseness of the lines in the spectra, and more reliable results are promised. [See also Abstracts Nos. 485 and 1300 (1904).] H. F. H.

1298. *Spectrum of the Nebulosity Surrounding Nova Persei.* **C. D. Perrine.** (Astrophys. Journ. 17. pp. 310–314, May, 1903. Lick Observatory Bulletin, No. 38.) —The region of this nebula known as condensation D was only dealt with, and the spectrum was photographed with a quartz spectrograph on the nights of October 31, November 1, 2, and 4, 1903, with an exposure of 34 hours. It was found that the spectrum did not resemble that of the Nova at that time, but strongly resemble the Nova's spectrum during the first few days of its greatest brightness. Moreover, the spectrum of the condensation is not that of a gaseous nebula; the author tends to the conclusion that the light is reflected light which was emitted by the Nova at the time of its greatest brightness. E. C. C. B.

1299. *New Star in Gemini.* **H. H. Turner.** (Roy. Inst., Proc. pp. 1–11, June 5, 1903.) **J. A. Parkhurst.** (Astrophys. Journ. 17. pp. 373–375, June, 1903.) **E. E. Barnard.** (Astrophys. Journ. 17. pp. 376–377, June, 1903.)—Turner gives an account of his discovery of Nova Geminorum, together with a list of previous "new stars." The theory is advanced that these are due to very distant suns or planetary bodies rushing into invisible nebulæ, and so bursting into intense incandescence. The secondary outburst is attributed to reflection of the original flare from the surrounding dark nebula, and to fit this theory the star would have to be about 2 × 10^{14} miles from our earth. Very delicate spectrum analysis at Lick observatory supports these views. Parkhurst gives a list of observed magnitudes for different dates, showing fluctuations similar to those of Nova Persei. Barnard gives estimates of magnitude made by comparison with neighbouring stars. It increased regularly from 8 to over 10 in about seven weeks up to May 19, 1903. The star appeared reddish at first, but subsequently became colourless. [See also Abstracts Nos. 472, 473 and 1295 (1904).] H. F. H.

1300. *Two Stars with Variable Radial Velocities.* **E. B. Frost** and **W. S. Adams.** (Astrophys. Journ. 17. pp. 381–382, June, 1903.)—The two stars *u* Herculis and 57 Cygni with spectra of the Orion type have been found to show large variations in their radial velocities. The former between February 19 and May 7 varied from − 65 to + 101 km. per sec.; it is a photometric variable of irregular period. The measurements are uncertain to several kilometres. The second star on May 16 and 17 showed velocities of — 114 and — 23 km. per sec. respectively; on the first plate the magnesium line $\lambda = 4481$ appeared to have a second component which was not visible on the second plate. [See also Abstract No. 485 (1904).] E. C. C. B.

1301. *Radiation Pressure and Cometary Theory.* **E. F. Nichols** and **G. F. Hull.** (Astrophys. Journ. 17. pp. 352–360, June, 1903.)—After giving theoretical considerations, an experiment with a laboratory comet's tail is described. Particles of lycopodium are allowed to stream through a channel in a highly exhausted vacuum tube, and a concentrated beam of light is allowed to fall perpendicularly on the stream. A considerable repulsion was observed, but a large part of this is considered to be due to gas action. The author concludes that we are now likely to be embarrassed in discriminating between different causes producing the repulsion of comets' tails. [See also Abstract No. 60 (1904).] J. W. P.

1302. *Precision in Stellar Positions.* **A. Abetti.** (Accad. Lincei, Atti, 13. pp. 162–164, Feb. 21, 1904.)—By meridional observations, about a thousand stars, 1st to 7th magnitude, have their positions now fixed within 0·01 sec. in right ascension and 0″·1 in declination. Some hundred thousand others (down to 9th magnitude), by a few differential meridional observations, have their positions fixed within 0·1 sec. and 1″·0 respectively. Beyond the 9th magnitude the task would be overwhelming were it not for photography; but photography is not more accurate than the aggregate result of continuous observation already is for the larger stars. A. D.

1303. *Circumzenith Instrument for Latitude Determination.* **F. Nušl** and **J. J. Frič.** (Zeitschr. Instrumentenk. 23. pp. 214–217, July, 1903. Bulletin Astron. 19. p. 261, 1902. II. pp. 370–372, Dec., 1903. Bull. Internat. de l'Acad. de Sciences de Bohéme.)—The paper discusses the working of the new method of observing zenith distances by placing a prism in front of the telescope objective, and observing the coincidence or interval between the images produced by (1) direct reflection from one face of the prism to the telescope, (2) by the rays reflected from a basin of mercury on to the under surface of the prism, and from thence reflected into the objective. The edge of the prism is placed horizontally in line with the axis of the telescope. Mention is also made of a further modification of the instrument by employing a bent telescope, involving the use of two extra mirrors. C. P. B.

1304. *Meteorites in the Friedrich-Wilhelm's University, Berlin.* **C. Klein.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 4. pp. 114–153, Jan. 21, 1904.)—Particulars and classification of the meteorites in the collection of the above museum, with complete list of the dates and places where the specimens fell. Analyses of the more remarkable specimens are given. L. H. W.

1305. *Registration of Star-Transits by Photography.* **H. Grubb.** (Roy. Dublin Soc., Proc. 10. 12. pp. 138–140, Feb. 10, 1904.)—The author points out that highly sensitive stationary plates are unsatisfactory. The new instrument described consists of a transit circle modified as follows: (1) The object glass is at the intersection of the horizontal axis, the lower end of the tube being open. (2) A clockwork-driven arc is attached to one end of a polar axis symmetrical with the object glass in such a way that the carrier and photographic plate can be set opposite the open end of the tube for any declination. The star image remains fixed relatively to the plate, while time is recorded by a series of lines from a shutter and electrically illuminated diaphragm on the axis of the transit instrument. H. F. H.

1306. *Stellar Photography.* **G. Boccardi.** (Accad. Lincei, Atti, 12. pp. 601–608, Dec. 20, 1903.)—Discussion of the degree of accuracy obtainable for measurement purposes by stellar photography under various conditions. The degree of accuracy attained is very great. A. D.

1307. *Pyrheliometry.* **C. Chistoni.** (Accad. Lincei, Atti, 12. pp. 625–628, Dec. 20, 1903.)—Table of observations at Sestola and Monte Cimono during 1900. [See Abstract No. 494 (1904).] A. D.

1308. *Occultation of α Tauri.* **L. Montangerand.** (Comptes Rendus, 138. pp. 551–552, Feb. 29, 1904.)—The times of immersion and emersion of the first magnitude star Aldebaran (α Tauri) are given as observed at the Observatory of Toulouse on February 24, 1904. C. P. B.

1309. *Absorption in the Solar Atmosphere.* **F. W. Very.** (Astrophys. Journ. 19. pp. 139–150, March, 1904.)—Starting from the view commonly accepted, that the diminution of radiation by the solar atmosphere, which increases as the wave-length diminishes, is to be attributed to selective scattering, or diffraction, by fine particles, and not to any true absorption by gaseous constituents of the media traversed by those rays, the author proceeds to explain the apparent anomaly that the Fraunhofer lines observed during an *annular* solar eclipse, proceeding therefore only from the regions near the edge of the sun, are not appreciably different in intensity from those observed on the centre of the disc in ordinary sunlight. He suggests their invariability may be due to the fact that when a mass of gas reaches a certain thickness the radiation from it as a whole is probably not appreciably increased by any increase in the thickness of the radiating stratum. A considerable portion of the paper is taken up by a discussion of Schuster's theory of the solar atmosphere, with which the author does not wholly agree. [See also Julius, Abstract No. 1039 (1902).] C. P. B.

1310. *Standard Velocity Stars at Pulkowa.* **A. Bélopolsky.** (Astrophys. Journ. 19. pp. 85–104, March, 1904.)—The paper contains the provisional results of the investigation of the velocities of the international fundamental stars, determined from micrometric measurement of spectra photographed with the new Pulkowa spectrograph, built by Toepfer, of Potsdam. The spectrum of iron, using either the induction spark or electric arc, has been used for comparison, and the spectrograph is provided with a device for constant temperature of the optical train. Detailed tables are given showing the velocities, &c., determined from each star. C. P. B.

1311. *Form of the Nebulosity around Nova Persei.* **O. Luyties.** (Astrophys. Journ. 19. pp. 129–138, March, 1904.)—The author describes the distortion phenomenon which is produced on all secondary radiations which have been induced by new or varying primary emanations. Two of the chief peculiarities of the Nova Persei nebulosity—(1) the extreme rapidity of its expansion, (2) its progressive retardation—appear to favour the suggestion that something of this character may explain its appearance. Tables are given from calculations of the distortion which would be produced by combinations of different values of the velocity of emanation and the area occupied by the evolved matter, and figures plotted showing the resultant curves. [See also Abstracts Nos. 1300 (1902) and 703 (1904).] C. P. B.

1312. *Photographic Observations of Comet*, 1903, *c.* (*Borelly*). **S. Albrecht.** (Astrophys. Journ. 19. pp. 121–128, March, 1904.)—Thirty-six negatives of this comet were secured between January 22 and August 18, 1903, with the Crocker telescope, &c., at the Lick Observatory. Three of the plates are reproduced, showing the rapid variation of the structure of the tails. Two tails were present, one long and straight, the other short and curved. C. P. B.

1313. *The Bishop's Ring of* 1902–1904. **F. A. Forel.** (Comptes Rendus, 137. pp. 380–382, Aug. 10, 1903; and 138. pp. 688–690, March 14, 1904.)—The Bishop's ring of August, 1903, appeared to the author exactly as that of 1884, to which he refers at some length, except that it was much paler; crepuscular lights were noticed in 1902 and 1903, but only at intervals—not continuously as in 1884. In the second paper the author points out that the Bishop's ring has almost continuously been observed after August, 1903, by himself, and by many others in different parts of the world, while the peculiar sunsets and sunrises remained discontinuous. He suggests that the Bishop's rings may be due to a closed ring of volcanic dust in the high atmosphere, and the crepuscular lights to an irregular belt of dust-clouds at lower level. [See also Abstract No. 728 (1904).] H. B.

1314. *Quadrifilar Azimuthal Balance.* **V. Crémieu.** (Comptes Rendus, 138. pp. 893–895, April 11, 1904.) **H. Poincaré.** (Comptes Rendus, 138. pp. 869–874, April 11, 1904.)—The arrangement described has a stability independent of the sensibility, and the latter can be made greater than that of any ordinary balance. The essential feature is that the beam is held up by the flotation (in mercury) of a plunger, and this is counteracted by the action of two bifilars. A model gives good results. Poincaré in the second paper deals with the mathematics of the sensibility and stability of the balance. J. W. P.

1315. *Height of the Leonids in* 1903. **M. Farman, E. Touchet,** and **H. Chrétien.** (Comptes Rendus, 138. pp. 1024–1026, April 25, 1904.)—The observations were made in the early morning hours of November 13–14 and 14–15 at Chevreuse and at Authon-la-Plaine, 28·7 km. from the former, and at a relative azimuth of + 10°. Of 83 meteorites counted, 28 were Leonids, and of the 22 simultaneously observed at both stations, 12 permitted of calculations after Klinkerfues and by graphic methods. The resulting means are: Height of appearance 103·6 km. (from 54 to 136), of disappearance 75·8 km. (33·4 to 131·6), length of trajectory 35·2 km. (13 to 62). H. B.

LIGHT.

1316. *Method of Investigating Optical Problems.* **G. Johnstone Stoney.** (Phil. Mag. 5. pp. 264–279, Feb., 1903. Paper read before Section A of the British Association, Sept., 1902.)—Several proofs exist that light within a uniform transparent medium may always be resolved into uniform flat wavelets. The proof by the Principle of Reversal (B.A. Report, 1901), not only shows, like the analytical method, that a resolution into flat wavelets exists, but further exhibits in each individual case details of the resolution and of the relations in which this resolution stands to neighbouring resolutions. This proof also has among its advantages that it can be applied to doubly refracting as well as to isotropic media. The paper aims primarily at developing a convenient way of applying the flat wavelet resolution of light to the investigation of optical problems that arise in cases where isotropic media are concerned, but it can also be generalised so as to provide for optical problems dealing with any medium, whether isotropic or doubly refracting. The mechanism of the method is then explained. An "optic axis" extends from the centre of the field of view, or "base-plane," to the observer. Round this centre is described a "reference-hemisphere" resting on the base-plane. Undulations of flat wavelets, which can be represented by radii of the reference-hemisphere, have their "guide-points" on the hemisphere projected as "index-points" on the circular base. This circle and its contents is called the "indicator-diagram," and it and its geometrical properties are employed in the enunciation of several theorems relating to wave phenomena.

G. E. A.

1317. *Utilisation of Old Sensitised Plates which have become Fogged.* **L. Vidal.** (Photographic Journ. 43. pp. 220–222; Discussion, pp. 222–223, Aug., 1903.)—The author refers to an article of his published in 1895, and reminds photographers that there is an easy means of making use of old plates which have become fogged owing to the time that has elapsed since the date of their manufacture. The method recommended by the author is that of treating the said plates with a 1 per cent. solution of potassium bichromate. The plates, after exposure in the camera, are immersed in the bath previously well filtered, and left for three to five minutes, washed for several minutes, and then put into the developer. The bichromate, in spite of the thorough washing, produces a retarding effect. While, without this treatment, a more or less intense fogging would be observed to spread suddenly over the plates, in this case the development proceeds gradually, and the negative image appears quite clear in the high lights. It is necessary to rather prolong the time of development to obtain the desired density, proving that the bichromate has no injurious action upon the latent image. As regards fogging due to the action of light, the treatment with bichromate will not remove this, any more than it will destroy the latent image due to rays of light reflected from the interior of the camera. Plates are sometimes so veiled with fog that it is impossible to make anything of them by employing the usual forms of procedure; while by submitting them to the action of bichromate previous to development all their good qualities are restored. The best method in such a case is to immerse the exposed plates one after the other in the bichromate bath for three or four minutes, and then to transfer them to an upright grooved trough through which there is a constant flow of water. The first bichromatised plate should then be placed in the developer, and each of the others in turn, according to their order of treatment. In the *discussion* which followed, **C. H. Bothamley** said that there was one point to be observed. The basis of the communication was that the light fog on the plate was not destroyed by the ammonium bichromate. (Owing to an error in translation, the author was made to refer to ammonium instead of potassium bichromate at the reading of the paper.) That was contrary to his experience. Abney was, he believed, the first to demonstrate that potassium bichromate destroyed the latent image produced by light, and the speaker had come to the same conclusion when he repeated the experiments with special precautions some years ago. In further experiments he made use of bichromate in order to differentiate between the effect produced by light and that produced by mechanical stress. He had repeated the experiments originated by Abney, and had tried to find the exact place in the film where the stress image was produced. The plates were scratched in a definite way, and afterwards exposed briefly to light, and it was found that by immersing the plates in bichromate, and then subjecting them to development, the image produced by the action of light disappeared, but the effect of stress remained and was developed. He was at present convinced that potassium bichromate, speaking chemically, did destroy the light image, and the utility of the method described by the author depended upon the use of a weak solution and a short treatment. If anybody tried the method on an exposed plate which he valued, it would be a very risky proceeding. **Swan** asked for the strength of solution that was found to be destructive to the latent image. **Bothamley** said that, so far as he could recollect, in the stress and light experiments the solution of bichromate was no stronger than 2 per cent. **Swan** suggested that the author's success was due to the weaker solution specified in his paper. C. E. A.

1318. *Effect of Transition Layer on Total Reflection.* **R. A. Houstoun.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 6. pp. 353–356, 1903.)—Drude gives (Wied. Ann., 1891) a formula, viz., $\tan \frac{1}{2}\Delta = \tan \frac{1}{2}\Delta_0 - \epsilon/\mu \sin \phi \tan \phi$, for the phase-difference Δ between the components of light polarised by total reflection at the surface of two media when a transition layer is present; Δ_0 is the phase-difference according to Fresnel's formula, and ϕ the angle of internal incidence. Observations by Jamin and Quincke having agreed with the older formula rather than with that which assumes the existence of a surface layer, two series of spectrometric measurements of Δ, μ, and ϕ are made with an old prism in which the layer is presumably large, and the values of Δ thus found differ so much from Δ_0 as to make very evident the effect of the transition layer. The values found for ϵ/μ were 0·0133 and 0·0126, ϵ being defined from another formula of Drude's. G. E. A.

1319. *Conversion of Rock-Crystal into the Amorphous State.* **M. Herschkowitsch.** (Zeitschr. Phys. Chem. 46. pp. 408–414, 1903. Phys. Chem. Lab. d. Optischen Werkstätte C. Zeiss, Jena, Aug., 1903.)—At the Paris Exhibition the firm of C. Zeiss were able to show three optically homogeneous plates of fused quartz about 10 mm. thick and 40 mm. in diam. To prepare plates of this kind somewhat special treatment of the natural quartz is necessary, partly because there is a sudden change in the expansion at 570°, which has a great tendency to crack the crystal, and partly because the half-fused product is so viscous that it is exceedingly difficult to obliterate air-bubbles or cracks if these are once present in the mass. This is largely got over by heating to 500° in a muffle furnace and plunging suddenly into a white-hot electrical furnace. The sp. gr. of amorphous quartz is 2·204, as compared with 2·651 for the natural crystal, and its refractive indices are shown by the following table:—

Fraunhofer Line.	Refractive Index.	Dispersion.
A	1·45397	A–D 0·00451
C	1·45645	C–D 0·00203
D	1·45848	
F	1·46322	D–F 0·00474
G	1·46697	D–G 0·00375

The relative dispersion v is 67·8. The transparency of amorphous quartz for the most refrangible ultra-violet rays is less than that of the natural crystals, but it is nevertheless highly transparent to all the rays up to 220 $\mu\mu$, which act at all strongly on an ordinary photographic plate; rays beyond 193 $\mu\mu$ are completely absorbed. The relative exposures for quartz and air are as follows:—

$\lambda = 361\ \mu\mu$	20 seconds, quartz	=	18–19 seconds, air.
275	20	=	16–17
257	20	=	15–16
231	20	=	12–13
214	20	=	11–12
199	180	=	1–2

T. M. L.

1320. *Solar Constant of Radiation.* **C. G. Abbot.** (Monthly Weather Rev. 31. pp. 587–592, Dec., 1903.)—A summary of two years' bolometer work at the Smithsonian Astrophysical Observatory, by Langley, F. E. Fowler, Jr., and the author. It is assumed that in the bolograph, the height d corresponding to a certain wave-length is proportional to the amount of energy of that wave-length, and that $\log d = m(\beta/\beta_0) \log a + \log (ke_0)$, where e_0 is the intensity of light of that wave-length outside the atmosphere, a the fraction transmitted by the atmosphere for the zenith sun, m the air mass, β and β_0 the observed and the standard barometer readings, and k a constant. As large extrapolations have to be made for atmospheric absorption, Langley regards the measurements as very uncertain; the regularity of the straight-line curve is, however, a favourable sign in the author's opinion. Since about November, 1902, the transparency has distinctly decreased, particularly for short wave-lengths; the diminutions decrease indeed with increasing wave-lengths fairly regularly from 20 to 2·3 per cent.; this would support the volcanic-dust hypothesis. The mean solar constant value, resulting from observations up to March 1903, is 2·229; from later observations, 2·08. The wave-length of maximum energy (for the light outside the atmosphere) seems to be 0·49 μ; it is probably smaller, for the rapid deterioration of the silvered glass surfaces makes the determination difficult. The above value would, according to Wien's law, and Lummer-Pringsheim's constant, give 5,920° as the temperature of the sun considered as black body. H. B.

1321. *Emissivity and Electrical Conductivity of Alloys.* **E. Hagen** and **H. Rubens.** (Deutsch. Phys. Gesell., Verh. 6. 4. pp. 128–136, Feb. 29, 1904.

Communication from the Physikalisch-Technische Reichsanstalt.)—The relation $(100 - R)\sqrt{K} = C_\lambda = K/\sqrt{\lambda}$, where K is a constant with the theoretical value 36·5, and C is constant for a given wave-length [see Abstracts Nos. 62 and 64 (1904)], is found to be true for alloys. The results of Guillaume for nickel-steel [see Abstract No. 227 (1904)] are confirmed, minimum conductivity being observed for steels containing about 30 per cent. Ni. Bismuth behaves normally when in the liquid condition, as shown by the metal itself and by the bismuth alloys of Wood and Rose. From the table of results a mean value of $C_{25\cdot5\mu} = 7\cdot29$ is found, and $K = 7\cdot29\sqrt{25\cdot5} = 36\cdot8$.

G. E. A.

1322. *Connection between Light Radiation and Temperature.* **H. Eisler.** (Elektrotechn. Zeitschr. 25. pp. 188–191, March 10, 1904.)—Langley has determined the amount of light radiated for a given expenditure of energy in the different wave-lengths of the spectrum. Lummer and others have given formulæ connecting energy with the wave-length and absolute temperature. By comparison of Langley's figures and the formulæ, the author arrives at the conclusion that the physiological effect of compound light is the sum of the several effects due to the lights of the various wave-lengths; and that for the black body and for platinum over the visible range there is a similar connection between light and temperature, the connection, in fact, being the same, apart from a constant factor. In considering the maximum efficiency which can be obtained in light radiation, regard must be had to the fact that the light can be emitted at various wave-lengths, and the efficiency in all cases will not be the same. Taking a wave-length of 0·53 μ, which according to Langley gives the greatest impression on the eye, and gives light of a greenish-yellow colour, the author gives reasons for supposing that an efficiency of 65 candles per watt might be obtained. But a light of this character is impracticable. Assuming, on the other hand, that a light corresponding generally to that emitted by the sun is to be considered, the maximum efficiency would be about 27 Hefner candles per watt.

W. H. S.

1323. *Detection of the Schumann Extreme Ultra-violet Rays by the Thermopile.* **A. Pflüger.** (Phys. Zeitschr. 5. pp. 71–72, Feb. 1, 1904. Physik. Institut d. Univ., Bonn., Jan., 1904.)—A first experiment failed, in which a spectrometer provided with fluorite optical parts and filled with hydrogen was used, probably owing to the absorption of these rays by the hydrogen. The effect of these rays on the thermopile was readily detected when the following apparatus was used. The spark was made to pass between aluminium electrodes which were mounted in a glass tube filled with hydrogen; this tube carried a side branch with a fluorite window. Immediately opposite this window and at 5 mm. distance was placed the fluorite window of a second tube which carried the thermopile; this tube was exhausted. A series of observations were made of the deflections of the galvanometer mirror connected with the thermopile; the two fluorite windows were now brought into contact, and it was then found that considerably greater deflections were observed. As 3 cm. of air absorb only 3 per cent. of the rays at $\lambda = 1860$, it is clear that the increase in deflection was due to the rays of very short wave-length, seeing that these are entirely absorbed by air. [See also Abstract No. 523 (1904).] E. C. C. B.

1324. *Anomalous Propagation of Light in Optical Instruments.* **G. Sagnac.** (Journ. de Physique, 2. pp. 721–727, Oct., 1903. Communication made to the Société Française de Physique, May 15, 1903. Comptes Rendus, 138. pp. 479–481, Feb. 22, 1904.)—Gouy discovered in 1890 that a peculiar change of phase occurs when light passes through a focus, the amount of the change being a half-period. To test his conclusions, he made one of the two mirrors in Fresnel's experiment concave. This gave semicircular fringes, which had a bright centre till the focus of the concave mirror was reached, and a dark centre at greater distances. Fabry employed an arrangement for Newton's rings in which each of the two reflecting surfaces gave a focus. When the surfaces were in close contact, rings with a black centre were obtained at all distances short of the first focus; then with a bright centre till the second focus was reached; and beyond this, again black. Zeeman, by a special arrangement with a plano-convex lens of Iceland spar, showed one reversal of phase at the focus of the ordinary, and another at the focus of the extraordinary rays. The author rejects previous explanations in favour of the following view: The theory of diffraction shows that oscillations of phase and of intensity are produced along the axis of a perfectly regular optical instrument illuminated by a point source. At the dark points the velocity of the waves is very small; and from each of these points to the next there is a progressive advance amounting in all to a half period, except in the case of the two which immediately precede and follow the focus. From the first of these to the second there is an advance of a whole period. These phenomena have escaped detection because they are masked by irregularities in the incident waves and in the instruments. A fuller exposition is to appear in the Journal de Physique. A. E.

1325. *Single-piece Lenses.* **T. H. Blakesley.** (Phys. Soc., Proc. 18. pp. 591–595, Dec., 1903.)—The lenses shown in the illustrations may be described as glass rods with convex or concave ends. The length measured along the axis being taken as the unit of length, the radii of curvature of the first and second surfaces are called x and y, reckoned positive when the concavity is towards the incident light. Diagrams are shown in which x and y are the co-ordinates of a point, so that each point represents a particular form of lens. Lenses in which the principal focus lies on the second surface are represented by the line $x = -(\mu - 1)/\mu$. Lenses which are telescopes (their focal lengths being infinite) are represented by $y - x = (\mu - 1)/\mu$. Lenses in which the focal length does not change for a small variation of μ are achromatic, and are represented by $y - x = (\mu^2 - 1)/\mu^2$. Lenses in which incident rays parallel to the axis undergo the same deviation at incidence as at emergence, are represented by the line $(2 - \mu)y + \mu x + \mu - 1 = 0$. Lenses of any given focal length (with the same distance between surfaces) are represented by a rectangular hyperbola whose major axis is $y + x = 0$.

A. E.

1326. *Testing Optical Mirrors during Construction.* **G. W. Ritchey.** (Astrophys. Journ. 19. pp. 53–69, Jan., 1904.)—The paper describes the methods in use at the Yerkes Observatory. The mirrors are supposed to be of silvered glass. The glass must be homogeneous and very perfectly annealed; the best optical crown glass is recommended. The thickness should be from $\frac{1}{6}$ to $\frac{1}{12}$ of the diam., and should be relatively greatest for the smallest mirrors. A large mirror should be supported at the back in its cell, with free access of air to the back, to prevent inequality of temperature. The backs of mirrors should be polished and silvered, as well as the fronts, to ensure equal radiation. In testing concave spherical mirrors, an "artificial star" is employed, consisting of a very small pinhole in a thin metal plate, with a bright lamp behind. It is generally preferable to have a totally-reflecting prism in contact with the pinhole plate, receiving light through a lens, from a lamp in a lateral direction. The pinhole should be a little to one side of the centre of curvature of the mirror, and its image will be formed at the same distance on the other side. When this image falls on the pupil of the observer's eye he will receive light from all parts of the mirror by rays of nearly normal incidence; and deviations from regularity will be seen as exaggerated elevations and depressions. When complete regularity has been attained, the surface has the appearance of being plane. To get the right position for the pinhole, a knife-edge is to be moved across the emergent cone of rays, and the observer is to note whether the shadow appears to move with or against the motion of the knife-edge. Preliminary information as to the general character of the mirror can be obtained by viewing the image of the pinhole with an eyepiece. It ought to appear exquisitely sharp and symmetrical. To test a plane mirror, a rather larger spherical mirror, figured with the utmost accuracy, is to be employed, placed at a large inclination in front of the plane mirror, so as to reflect on to it the light from a pinhole, which will be reflected back and form an image close to the pinhole, where it will be received on the observer's eye. In making a paraboloidal mirror, a spherical mirror of the desired size is first executed, of such curvature that it will osculate the paraboloid at the margin. The central portions are then excavated, the depth of excavation at the vertex being of the order of one thousandth of an inch. In testing the mirror, the pinhole is to be virtually at the focus, and the parallelism of the reflected beam is tested by means of a plane mirror large enough to return the whole beam. Practically, a small diagonal mirror, placed between the focus and the parabolic mirror, receives light from a pinhole placed laterally, near to which an image is formed by the returned rays. When the paraboloid is true, it will appear plane to an observer on whose eye the image falls. Small convex hyperboloidal mirrors, to be used as in the Cassegranian construction, are tested in position in a very similar manner, a large plane mirror being employed to make the beam return upon its course. A. E.

1327. *The Optical Society and the National Physical Laboratory.* **R. T. Glazebrook.** (British Optical Journ. 3. pp. 133–138, Feb., 1904.)—This address is mainly devoted to an account of the arrangements that have been made for testing optical glass. The indices of refraction for certain lines of the spectrum are determined by a form of Pulfrich's refractometer, in which the rays that reach the observing telescope have been refracted at grazing incidence from the specimen under test to a standard block of highly refractive glass. Specimens sent for test must have two faces at right angles. One of these must be plane-polished and the two must meet in a sharp edge. The plane-polished face may be from 1/4 in. to 1/2 in. square. For testing absorbing power in different parts of the spectrum, Martens' modification of the König spectrophotometer is employed. The light from a horizontal slit is divided into two separate beams by two collimating lenses of special construction, placed side by side. These two beams fall respectively on the two slits of the instrument itself, and, by a train of lenses and prisms, are made to yield spectra in a focal plane which contains a diaphragm for permitting any desired portion of the spectrum to pass. A double-image prism interposed in the middle of the train splits up each of the spectra into two of opposite polarisations; and a nicol forming part of the eyepiece is rotated till two of the four spectra (one from each slit) appear equal in intensity. The ratio of their actual intensities will be $\tan^2 \theta$, where θ is the rotation of the nicol from the zero position. If, after this observation has been made, a plate of any absorbing material is interposed in the path of one of the two beams, a second observation will show the absorption of the plate for the particular part of the spectrum employed.

A. E.

1328. *Vision in Dim and Bright Light.* **O. Lummer.** (Deutsch. Phys. Gesell., Verh. 6. 2. pp. 62–76, Jan. 30, 1904.)—According to Kries's theory, the cones of the retina form our colour-perceptive apparatus, the rods being, not only colour-blind, but also more adaptable to light sensations, so that in a dim light the rods convey to the brain the impression of colourless brightness before the cones perceive colour. On the fovea centralis and on part of the macula lutea there are cones only, but near the edge of the retina the rods predominate. Thus in direct vision the cones are alone active; in indirect vision both are active. After mentioning some recent anatomical discoveries in relation to the process of vision, several experiments are described supporting Kries's theory. Colour-blindness is then explained by assuming that the retina of a colour-blind person contains rods in addition, where that of the normal person has cones only. This supposition is tested by experiment, and the further assumption is made that the rods in the fovea centralis and also part of those in the macula lutea have lost their power of adaptation, but have acquired a greater sensitiveness than the rods of the normal retina. G. E. A.

1329. *Double Refraction in Matter moving through the Ether.* **D. B. Brace.** (Phil. Mag. 7. pp. 317–329, April, 1904.)—A heavy beam, pivoted between floor and ceiling, is made to carry a horizontal trough 413 cm. long. A polarised ray of sunlight is then led backwards and forwards through the trough for a total distance of 2,856 cm., and tested for traces of double refraction, by means of a "sensitive strip" of mica [see Abstract No. 1013 (1904)], for different positions of the trough with regard to the earth's orbital motion. In no case could a change be observed, and it is concluded that, to the order of sensibility obtained, there is no double refraction in water due to its motion through the ether. The greatest change to be expected was about 1,600 times as great as the smallest effect that could be observed. Experiments with glass led to the same conclusions, viz., that the Fitzgerald-Lorentz contraction hypothesis cannot explain the negative results of the interference experiments, and either that the ether moves with the embedded matter, or that the effect of the relative motion on the intermolecular forces, and the possible consequent relative change in dimensions, are very small. [See also Abstract No. 1000 (1903).] G. E. A.

1330. *Metallic Reflection of Selenium.* **C. K. Edmunds.** (Phys. Rev. 18. pp. 193–229, April, 1904.)—The work consists of two parts: (1) The determination of the phase condition and the azimuth of restored polarisation of the reflected ray for different angles of incidence for red, yellow, and blue light; (2) The direct observation of the reflecting power for various wave-lengths and at different angles of incidence by means of the spectrophotometer. It is found that the elliptical polarisation of plane-polarised light by reflection from vitreous selenium is such as is characteristic of a transparent substance for wave-lengths in the red, and that the reflected light assumes more and more the characteristic of light reflected from true metal surfaces as the wave-length of the light is decreased till, in the blue, selenium acts quite like a metal. The principal azimuth increases as the wave-length decreases, while the principal incidence passes through a minimum at about 680 $\mu\mu$, and then remains fairly constant. J. W. P.

1331. *Determination of Refractive Indices by means of Channeled Spectra.* **S. R. Williams.** (Phys. Rev. 18. pp. 280–294, April, 1904.)—If the light reflected from two parallel optical surfaces be examined in a spectroscope, interference bands will be seen; the centre of a dark band occurring when $2\mu D = 2N\frac{\lambda}{2}$, and the centre of a light band when $2\mu D = (2N + 1)\frac{\lambda}{2}$, where D is the linear thickness of the space between the surfaces, λ the wave-length, and N some whole number. Using the sun as source of light, the Fraunhofer lines will be seen at the same time as the interference bands, and they furnish a scale of reference for every interference band. If two dark bands appear in the parts of the spectrum corresponding to λ_1 and λ_2, then we will have $2\mu_1 D - N\lambda_1$ for the longer wave-lengths, and $2\mu_2 D = (N + m)\lambda_2$ for the shorter, whence, assuming $\mu_1 = \mu_2$, we obtain $N = \frac{m\lambda_2}{\lambda_1 - \lambda_2}$. If now a wedge-shaped cell be employed so that the thickness can be varied, and if, in the variation of the thickness, m bands are shifted past a definite point in the spectrum for which the value of N is to be found, and n is the ratio of the bands between two definite wave-lengths, λ_1 and λ_2 before and after the variation in thickness, then $N = \frac{mn}{1 - n}$. We are now able to determine the value of μ for any transparent substance. For, if we take as a medium of reference a substance of index μ_r which is accurately known, $2\mu_r D = N_r\lambda$. In the case of the body whose index is to be determined, $2\mu_e D = N_e\lambda$. D and λ being the same, we have $\mu_e = \frac{N_e}{N_r}\mu_r$. A concave grating was used of 10 ft. focus, and mounted in the usual way; the slit was, however, removed from the intersection of the rails and placed a considerable distance further back towards the source upon an extension of the grating rail. The beam of sunlight after passing through the slit was focussed by a lens through a right-angle prism, so that an image of the slit was thrown upon the wedge-shaped cell. The rays reflected back from the cell were then totally reflected by a second right-angle prism, and passed directly to the grating. The two prisms were placed side by side vertically over the grating rail, and the cell was set at such a distance from the grating rail that the image of the slit focussed upon it acted as if it were formed at the intersection of the rails; in other words, the distance of the second right-angle prism from the intersection of the rails, measured along the grating rail, was equal to the distance of the cell from the grating rail. In this way the condition for perfect focus was obtained. The wedge-shaped cell was made by two strips of plate glass clamped together with cork distance pieces between them; the necessary angle between the plates was obtained by manipulation of the clamps. Air was used as the reference film, and a cork diaphragm was put in the cell, cut to such a shape that at one end the slit image fell in part upon the air film and part upon the liquid film, while at the other end it fell only upon the liquid film. Evidently if the thickness of the cell varied along a vertical section, *i.e.*, along the slit image, the interference bands would appear distorted. The proper adjustment of the cell in this sense was carried out by altering the clamps until the bands were vertical and well defined. Care had also to be taken that the light was incident normally upon the cell, and further, that the temperature was kept constant. The indices of refraction of many liquids were measured by this method, the observations being made upon photographs taken of the bands. It will be noticed that at one thickness of the cell the bands obtained with the reference air film and the liquid film were photographed one above the other, while at the second thickness the bands due to the liquid film only were procured. The measurements extend from $\lambda = 6867{\cdot}4$ to $\lambda = 3968{\cdot}6$, and were carried out for water, alcohol, α-monobromonaphthaline, oil of cinnamon, benzol, and olive oil.

E. C. C. B.

1332. *Influence of the Earth's Motion on the Intensity of Light.* **A. H. Bucherer.** (Ann. d. Physik, 11. 2. pp. 270–283, May 14, 1903.) **P. Nordmeyer.** (Ann. d. Physik, 11. 2. pp. 284–302, May 14, 1903. Extract of the Bonn Dissertation.)—Fizeau arrived at the conclusion that on the hypothesis of a motionless ether the intensity of sources of light on the earth is affected to a measurable extent by the earth's motion in its orbit round the sun. If v is the velocity of light, u that of the earth, it should, according to Fizeau's reasoning, be increased or diminished in the ratio $1 \pm \frac{2u}{v}$, according to the position of the point of observation with reference to the source and the earth's motion. The ratio in question is $1 \pm \frac{1}{5000}$ approximately. Poincaré is quoted as saying it is quite impossible to measure the intensity of light to that degree of accuracy. Nordmeyer undertook, with Bucherer's assistance, a new experimental investigation of this question, with the result that no influence of the earth's motion could be detected. In the present paper the author discusses the same question theoretically, first on the Maxwell-Hertz theory, then on the theory of Lorenz. He arrives in each case at the conclusion that no influence can be shown on theoretical grounds to exist—at least if squares and higher powers of u/v are to be neglected. In the second paper Nordmann gives an account of his experiments undertaken at Bucherer's suggestion. The experiments are described at length. It would be impossible to do justice to them in abstract without reproducing the diagrams. The result is, as above mentioned, that no influence of the earth's motion can be proved to exist, although it has been asserted not only by Fizeau but by Ketteler and Eötvös.

S. H. B.

1333. *Metalloptik and Maxwell's Theory.* **E. Cohn.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 24. pp. 538–542, April 23–30, 1903.)—The author refers first to the experimental investigations of Hagen and Rubens, expressing his own opinion that the variety of the observed phenomena of metalloptics (dispersion and selective absorption) cannot be represented by expressions containing two constants $\epsilon\mu$ and $\lambda\mu$, as in Maxwell's theory (ϵ is dielectric constant, μ permeability, λ conductivity). But these investigations show that for a very large class of bodies Maxwell's equations hold good to an unexpected extent, and they give ground for hoping that the dielectric constant for metals may be determined hereafter approximately. He then considers Planck's theoretic deduction of the results obtained by Hagen and Rubens. Planck requires to calculate the intensity of the reflected light R^2, or in the author's notation R. He makes two assumptions, namely, (1) that $\left(\frac{2\pi}{\gamma}\right.$ being the periodic time$\left.\right)$ $\frac{\nu\varepsilon}{\lambda}$ is very small, (2) that (μ_0 and ε_0 being the permeability and dielectric constant for air) $\frac{\mu}{\mu_0}$ is not great. And from these assumptions we find—

$$1 - R = 2\sqrt{2\frac{\mu}{\mu_0}\frac{\nu\varepsilon_0}{\lambda}}.$$

This is compared with experimental results. For metals not ferromagnetic the first assumption gives $1 - R = 2\sqrt{2\frac{\nu\varepsilon_0}{\lambda}}$, which is the approximate result obtained by Hagen and Rubens. Further investigations may throw light on the existence of the dielectric constant ε for such metals. For ferromagnetic metals the value of μ/μ_0 becomes important. It is found that the observed values of $1 - R$ are greater than the calculated values $2\sqrt{2\frac{\nu\varepsilon_0}{\lambda}}$ in the case of long waves. This might be explained by giving to $\frac{\mu}{\mu_0}$ a value different from unity. But then we should expect that with further increase of the wave-length the deviations from the calculated value should increase, which, according to Hagen and Rubens, is not the case. It is necessary, the writer thinks, to treat ε as an unknown value. S. H. B.

1334. *Integral of the Equations of Wave Motion which Corresponds to Doppler's Principle.* **E. Kohl.** (Ann. d. Physik, 11. 3. pp. 515–528, June 4, 1903.)—A source of light is supposed to move with velocity c, not necessarily constant, along a path not necessarily rectilinear. It started, from the origin O, t seconds ago, and is now at Q, having passed through P in its course. The electrodynamic wave, which originated from the source while at P, travels with the velocity of light (denoted in the paper by an impossible-to-be-written hieroglyph which we will call B), and it reaches a fixed point M ($PM = r$) at the same time as the source arrives at Q. It has been shown by the writer in a former paper [see Abstract No. 281 (1904)] that, were c constant and the path of the source rectilinear, the component oscillations at any point in space would be represented by differentiation of the function—

$$(1)\ldots\ldots\ldots\ldots\ldots V = \frac{1}{r\left(1 - \frac{c\cos\theta}{B}\right)} \begin{matrix}\sin\\ \cos\end{matrix} \frac{2\pi}{\tau_0}\left(t - \frac{r}{B}\right)$$

where θ is the angle between r and the path of the source, and τ_0 the time of oscillation. And V satisfies the equation (2) $\Delta V = \frac{1}{B^2}\frac{d^2V}{dt^2}$. In the present work the more general case is treated of c varying continuously in magnitude and direction, and it is shown that in this general case (2) is satisfied. In the course of the investigation the function $U = \frac{1}{r}\frac{d}{dt}\left(t - \frac{r}{B}\right)$ is employed. It is observed that U and V are both defined with reference to the same two points P and M. And in the second part of the investigation the writer deduces the Maxwell-Boltzmann field equations from the function U in the general case of non-conducting space, obtaining results in agreement with those given by Wiechert. S. H. B.

1335. *Complementary Terms to be added to Hertz's Equations to explain the Partial Displacement of Waves of Light when passing through Moving Matter.* **E. Mathy.** (Journ. de Physique, 3. pp. 316–319, April, 1904.)—Hertz's equations under consideration are as follows :—

$$\left.\begin{array}{c}\dfrac{d(\mu a)}{dt} - [\mu a] = \dfrac{dQ}{dz} = \dfrac{dR}{dy} \\ \text{with two corresponding equations}\end{array}\right\}\ldots\ldots\ldots\ldots(\text{I.})$$

and—

$$\left.\begin{array}{c}\dfrac{d.\mathrm{KP}}{dt} - [\mathrm{KP}] = \dfrac{d\gamma}{dy} - \dfrac{d\beta}{dz} \\ \text{with two corresponding equations}\end{array}\right\}\ldots\ldots\ldots(\text{II.})$$

[See Hertz's work on the electrodynamic theory of moving bodies for explanation of the symbols.] The complementary terms $[\mu a]$, &c., and [KP], &c., in the above system are introduced to express the motion of the surface through which the electric or magnetic flux is passing. The second members of the above system of equations have the same form as in the case of bodies at rest. The writer's correction of the equations is to multiply the second members of the system I. by $(1 + A(\xi + \eta + \zeta))$, and the second members of system II. by $(1 + B(\xi + \eta + \zeta))$, in which (ξ, η, ζ) is the vector velocity of the moving matter, supposed very small in comparison with that of light, and A and B are the coefficients of the second kind for electricity and magnetism respectively. Without these connections Hertz's equations cannot explain the experiments of Fizeau. On a certain assumption the writer's results express the views of Fresnel. S. H. B.

1336. *Polaristrobometrograph or Registering Polariscope.* **G. Gaillard.** (Comptes Rendus, 138. pp. 853–854, April 5, 1904.)—An apparatus for measuring the velocity of certain reactions in which change of rotary power takes place. A Laurent half-shadow polarimeter is used with the eyepiece removed, and in its place a cinematograph ; this last is driven by an electric motor, and by means of a tangent screw this also turns a spindle carrying a cam. This cam, as the spindle revolves, gives a slight turn to the analyser of the polarimeter. The cinematograph gives from five to ten images a second, and from these it is possible to read the angle through which the analyser has been turned in order to obtain equality of tint in the two light-beams. Monochromatic violet light is used for the illumination. E. C. C. B.

1337. *Kathodo-Luminescence and the Negative Pole Spectrum of Nitrogen.* **P. Lewis.** (Astrophys. Journ. 17. pp. 258–269, May, 1903.)—An account of some experiments undertaken to prove that the negative glow in nitrogen is due to kathodo-luminescence, that is to say, that it is due entirely to the discharge of kathode streams, and not in any way to the actual carrying of the discharge. A long, straight vacuum tube was employed, with the kathode in the centre and an electrode at each end ; photographs of the spectra of the discharge were taken with a slit as long as the whole discharge, *i.e.*, 15 cm. Comparison was made between the spectra of the various discharges obtained by varying the conditions in the following ways: Earthing one or more of the electrodes, introducing a condenser and spark-gap, self-induction, and by use of the Tesla discharge. The author sums up his observations in the following conclusions: The negative glow spectrum of nitrogen is due to kathode rays. The intensity of the negative band spectrum with the ordinary discharge is solely dependent upon the distance from the kathode, and is independent of changes in the potential gradient. The positive spectrum is present in all parts of the tube, and its variable intensity depends in large part upon the potential gradient. The presence of the negative bands in the spectrum of all parts of a tube when strong discharges are used is due to the discharge of kathode rays from the walls of the tube. The enhancement of the negative bands by self-induction is due to the slower rate of oscillation, permitting a more complete discharge of negative electricity, which requires more time than the positive. [See also next Abstract.] E. C. C. B.

1338. *Spectrum of the Electrodeless Discharge in Nitrogen.* **P. Lewis.** (Phys. Rev. 18. pp. 124–125, Feb., 1904. Abstract of a paper presented to the American Physical Society, Dec. 30, 1903.)—Some preliminary observations upon the spectrum of the electrodeless discharge in nitrogen. A spherical glass bulb was employed with a quartz window, and around it was a pasteboard cylinder with eight turns of copper wire, through which an oscillating discharge was sent. Photographs were taken of the discharge, and amongst other facts noticed was the presence of the negative glow bands, which are supposed to be due to the kathode streams only. The author suggests that they are caused by electrostatic charges from the glass walls of the tube. Of the positive bands Deslandres' third group (with head at $\lambda = 3{,}000$) was missing, while the second and first are fairly strong. [See preceding Abstract.]
E. C. C. B.

1339. *Infra-red Emission Spectrum of the Mercury Arc.* **W. W. Coblentz** and **W. C. Geer.** (Phys. Rev. 16. pp. 279–286, May, 1903.)—The radiation from a modified form of Arons lamp was examined by means of a mirror spectrometer with a rock-salt prism, and a Nichols radiometer was used to measure the distribution of the energy. The Arons lamp was provided with a fluorite window for wave-lengths up to $6\,\mu$, while a rock-salt window was employed from 6 to $9\,\mu$. A direct-current of 6 amps. was used throughout. It was found that the energy radiated consists of a series of emission bands at $\lambda\lambda = 1\,\mu$ and $5\,\mu$ with a slight indication of a band at $\lambda = 3\,\mu$; this indicates a low temperature like that of gases in vacuum tubes. By means of a series of control measurements the radiation due to the hot walls of the lamp was determined and deducted. Kayser and Runge, in their paper upon the spectrum of mercury, from the formula of the triplet series, predicted a triplet at $\lambda\lambda = 0{\cdot}9497\,\mu$, $0{\cdot}6595\,\mu$, and $0{\cdot}5906\,\mu$, though the wave-lengths may be rather larger; the authors found maxima at $\lambda = 0{\cdot}97$, $1{\cdot}045$, $1{\cdot}285$, $4{\cdot}28$, $4{\cdot}53$, $4{\cdot}73$, $5{\cdot}20$, $5{\cdot}50$, and $5{\cdot}73\,\mu$. Evidently the first of these agrees with Kayser and Runge's prediction of $0{\cdot}9497\,\mu$, but the radiometer failed to detect the other members of this triplet. Again, the frequency difference between the maxima at $\lambda\lambda = 1{\cdot}045$ and $1{\cdot}285\,\mu$ is 1,787, while the constant frequency difference between the second and third members of the mercury triplets is 1,767. This certainly appears as if the two maxima were indeed part of another triplet; if that were so, the first member should be at $\lambda = 3{\cdot}05\,\mu$, using Kayser and Runge's value for the constant frequency difference between the first two members of a triplet. As was pointed out, the authors found doubtful indications of an emission band at about $\lambda = 3\,\mu$. This is probably, therefore, the first member of the triplet. A curious fact further noticed is that the wave-lengths of the bands at $\lambda\lambda = 0{\cdot}97,\ 1{\cdot}04,\ 1{\cdot}29\,\mu$, when multiplied by 4·4, give almost exactly the wave-lengths of the bands observed at $\lambda\lambda = 4{\cdot}28,\ 4{\cdot}53$, and $5{\cdot}73\,\mu$.

E. C. C. B.

1340. *Spectra of Gases and Metals at High Temperatures.* **J. Trowbridge.** (Amer. Acad., Proc. 38. No. 25. pp. 681–688, May, 1903. Phil. Mag. 6. pp. 58–63, July, 1903.)—A further account of experiments upon the discharge of heavy currents through gases under reduced pressure in capillary tubes. These capillaries are made of quartz or glass, and vary in diameter from 1 to 2·5 mm. The author sums up his work in the following conclusions: The metallic lines due to terminals in rarefied hydrogen or air when these terminals are 1 cm. apart exhibit reversal. The reversal is coincident with the wave-length of the line in air, while the spectrum of the line on the least refrangible side is much broadened. This seems to indicate a gaseous product—an oxidation or reduction due to the dissociation of the water vapour present. Spark spectra of metals present complicated reactions of gases with the metallic vapours. The metallic vapour carries the main portion of an electric discharge when these terminals are within 3 mm. of each other in rarefied hydrogen or air. The gaseous ions, if the dissociation occurs, give little light. Since metallic lines differ in the ease with which they appear, some not even appearing under quite favourable conditions, it seems desirable to be cautious in speculations in regard to stellar types. [See also Abstracts Nos. 73 and 77 (1904).] E. C. C. B.

1341. *Wave-length of the Magnesium Line at* $\lambda = 4481$. **J. Hartmann.** (Phys. Zeitschr. 4. pp. 427–429, May 1, 1903. Astrophysikal. Observatorium, Potsdam, April 9, 1903.)—This line is of considerable importance in stellar spectroscopy on account of its presence in so many stars and its consequent employment in measurements of velocities in the sight line, since the line lies in the most actinic portion of the spectrum. The usually accepted wave-length of this line is considerably in doubt on account of its being so broad and diffused when observed in the ordinary magnesium spark. This fault is, however, mitigated to a considerable extent if the spark is surrounded with an atmosphere of hydrogen, and self-induction is employed; a still better result is obtained if the surrounding atmosphere be considerably reduced in pressure, and if a spark-gap in air be placed in series. The final mean of measurements made by comparison with the lines of the spectrum of the iron arc was $\lambda = 4481{\cdot}397 \pm 0{\cdot}002$. E. C. C. B.

1342. *Radiation of Helium and Mercury in a Magnetic Field.* **A. Gray** and **W. Stewart,** with **R. A. Houstoun** and **D. B. McQuistan.** (Roy. Soc., Proc. 72. pp. 16–21, July 8, 1903.)—The observations were made upon the red, yellow, and green lines of helium ($\lambda = 6678$, $\lambda = 5876$, and $\lambda = 5016$), and upon the green line of mercury ($\lambda = 5461$). The readings of the last line were complicated by the fact that the structure of the line is very complex; the line appears to consist of a single bright line with a triplet of faint satellites upon the violet side, and a triplet or doublet of faint lines upon the other side. The magnet used was a very powerful one, but owing to the weakening of the light in the higher fields it was not generally possible to work with higher fields than 10,000 c.g.s. units. The spectroscopic apparatus was an echelon grating of twenty-six plates, and an auxiliary constant-deviation instrument for the preliminary analysis of the light. The first observations were made at right angles to the lines of force, and the results were used to calculate the values of $\frac{d\lambda}{H\lambda^2}$ and of the ratio $\frac{e}{m}$ of the electron by the formula $\frac{e}{m}=\frac{2\pi V d\lambda}{H\lambda^2}$, where V is the velocity of light, 3×10^{10} cm. per sec. In every case the normal triplet was obtained, and the separation between the extreme components was found to be proportional to H up to fields of 10,000 c.g.s. The following table gives the results :—

Substance.	Wave-length. 10^{-10} cm.	$\frac{d\lambda}{H}$	$\frac{d\lambda}{H\lambda^2}$	$\frac{e}{m}$
Helium	5,016	$1{\cdot}61 \times 10^{-5}$	$6{\cdot}41 \times 10^{-5}$	$12{\cdot}1 \times 10^6$
„	5,876	$2{\cdot}07 \times 10^{-5}$	$6{\cdot}00 \times 10^{-5}$	$11{\cdot}3 \times 10^6$
„	6,678	$2{\cdot}90 \times 10^{-5}$	$6{\cdot}49 \times 10^{-5}$	$12{\cdot}2 \times 10^6$
Mercury	5,461	$2{\cdot}12 \times 10^{-5}$	$7{\cdot}12 \times 10^{-5}$	$13{\cdot}4 \times 10^6$

In the case of the green line of mercury the field was increased up to 13,000 c.g.s., when the centre component of the normal triplet was doubled, while each of the outer components was tripled. The polarisation of the two triplets and of the central doublet was the same as that of the lines from which they originated, namely, that of the lines of the normal triplet. In all fields up to 13,000 c.g.s. the faint companion to the helium D_3 line was not tripled but only doubled. Observations were also made along the lines of force for the lines dealt with above. The normal doublet was observed up to about 10,000 c.g.s., and the separation between the two components was found to be proportional to the field strength. The numbers obtained are given in the following table :—

Substance.	Wave-length.	$\frac{d\lambda}{H}$	$\frac{d\lambda}{H\lambda^2}$	$\frac{e}{m}$
Helium	5,016	$1{\cdot}75 \times 10^{-5}$	$6{\cdot}95 \times 10^{-5}$	$13{\cdot}1 \times 10^6$
„	5,876	$2{\cdot}24 \times 10^{-5}$	$6{\cdot}50 \times 10^{-5}$	$12{\cdot}3 \times 10^6$
„	6,678	$3{\cdot}13 \times 10^{-5}$	$7{\cdot}01 \times 10^{-5}$	$13{\cdot}2 \times 10^6$
Mercury	5,461	$1{\cdot}88 \times 10^{-5}$	$6{\cdot}31 \times 10^{-5}$	$12{\cdot}0 \times 10^6$

During the work Runge and Paschen's paper appeared. [See Abstract No. 216 (1903).] E. C. C. B.

1343. *Comparison of Some Spectrophotometric Results.* **E. Hertzsprung.** (Phys. Zeitschr. 5. p. 84, Jan. 15, 1904.)—A table is given showing the relative intensities of the spectra of the sun and of a standard candle for different wave-lengths. There are six columns in the table, the first giving the wave-length, which lies between 0·43 μ and 0·69 μ, and the second the logarithms of the corresponding intensity in the spectrum of the standard candle, which have been smoothed from the general radiation formula. In the third column the logarithms of the intensities of the solar spectrum, as found by Langley, are given, and in the fourth the values of a certain arbitrary relation between the numbers in the second and third columns. The fifth and sixth columns contain the logarithms of the ratios between the intensities of the two spectra as actually determined in two sets of experiments by Köttgen. There is a striking agreement between the values given in the fourth and fifth columns, which is interesting considering the very different methods by which they were arrived at. [See Abstract No. 1416 (1904).] E. C. C. B.

1344. *Spectrum of the Afterglow of the Spark Discharge in Nitrogen at Low Pressures.* **P. Lewis.** (Phys. Rev. 18. pp. 125–128, Feb., 1904. Abstract of a paper presented to the American Physical Society, Dec. 30, 1903.)—The author some time ago discovered the existence of an afterglow in nitrogen which could only be produced when the nitrogen was as pure as possible, although it seemed necessary that an exceedingly small quantity of oxygen be present. [See Abstract No. 2000 (1900).] The spectrum of this glow has now been photographed, using a vacuum tube with aluminium electrodes, and was found to contain four unknown bands or lines at $\lambda = 6240$, $\lambda = 5780$, $\lambda = 5240$, and $\lambda = 5410$, Deslandres' second and third groups of bands in the positive spectrum of nitrogen, the stronger mercury lines, and four pairs of the strongest ultra-violet aluminium lines, as well as a number of unidentified lines. The use of platinum for aluminium electrodes substituted some new lines, apparently not platinum, for the aluminium lines, and gave some new bands degraded towards the red. The presence of the aluminium lines in regions not traversed by the main discharge is very interesting, and it is difficult to see how J. J. Thomson's hypothesis of polymeric change in the nitrogen will explain luminosity in the aluminium particles distributed through it. E. C. C. B.

1345. *Spectrum of the Glow Discharge at Atmospheric Pressure.* **G. A. Hemsalech.** (Manchester Lit. and Phil. Soc., Mem. 48. 10. pp. 1–11, March, 1904. Physical Lab. of the University, Manchester.)—An investigation into the spectrum of the glow which is formed on the electrodes when the discharge from an induction coil is passed through gases at atmospheric pressure; this was undertaken with particular reference to W. Huggins' and Lady Huggins' discovery that radium, in an atmosphere of air at ordinary temperature and pressure, spontaneously emits a spectrum which is very similar to the negative band spectrum of nitrogen. [See Abstract No. 103 (1904).] The glow is best obtained in the case of the discharge at atmospheric pressure by inserting a self-induction in the circuit and heating the electrodes. In this case the glow is very brilliant and sometimes extends 5 to 8 mm. up the electrode and is entirely confined to the surface of the metal. From its appearance when viewed in a revolving mirror the glow occurs at just the one and then the other electrode in accordance with the alternations of the oscillations in the discharge and, further, must be almost momentary. In the case of the discharge in air between electrodes 1 cm. apart it was found that certain bands, viz., the positive nitrogen bands, extend right across the spark-gap; the line spectrum of nitrogen emerges a short distance from the anode, and in the kathode glow the two principal bands of the nitrogen negative band spectrum are seen ($\lambda = 3914$ and $\lambda = 4278$), this being the most brilliant portion of the whole discharge. A table is given of the wave-lengths of the chief bands in the glow discharge in air compared with those in the radium glow and those in the positive and negative bands as observed *in vacuo.* A very striking similarity is to be noticed between the first two spectra. The effect of increasing the self-induction was tried in the case of the glow discharge; it was found that the negative bands disappeared and were replaced by the positive bands. In experiments upon the glow in hydrogen, when a copper electrode was used, a green vapour was constantly seen over the opposite wire, which looks as if the copper wire were disintegrated, and the vapour, instead of being deposited upon the opposite electrode, were repelled from it, forming a luminous cloud above it. When the glow was formed upon a platinum wire the negative nitrogen bands were seen, due no doubt to the nitrogen excluded in the platinum. When the glow is produced upon a platinum wire in oxygen the spectrum is that of the elementary line spectrum with the most intense line at $\lambda = 4415{\cdot}3$. The nitrogen bands were also visible. The behaviour of the calcium lines in the glow was also noticed; in the nitrogen glow the H and K lines were very strong, especially K, while the line at $\lambda = 4226$ is feeble. In hydrogen the reverse is true, as the blue line at $\lambda = 4226$ is very strong at the expense of the H and K lines; in oxygen, again, the blue line is very strong, while the K line is only just visible. The author is of the opinion that the line spectrum of nitrogen is due to the vibrations of the positive ions—vibrations which may possibly be within the ions themselves and which are due to collision or combination with the electrons. The negative band spectrum is the result of encounters between the negative ions and the electrons. The positive band spectrum is due to the encounters between the positive and negative ions, or between ions and molecules. His theory of the radium glow spectrum is as follows: Assuming that radium is able to absorb negative ions of nitrogen, then as these diffuse into the radium they will encounter the stream of electrons moving outwards. These collisions will give the negative nitrogen bands. Supposing, further, that the negative ions in diffusing into the radium are deprived of several electrons so that they actually become positive ions, then the number of free electrons and of positive ions in the radium will increase. Eventually these, owing to overcrowding, will be again given up and will form the two radiations, the α and β, the former being the positive ions of nitrogen. These α particles will, on their way out, encounter the incoming negative ions and give rise to the positive bands of nitrogen. The γ-rays, according to the author, may perhaps be explained by assuming an impulsive expulsion of electrons, giving very abrupt impulses to the ether. According to these theories radium acts like a condenser, it absorbs negative ions of nitrogen, transforms them into positive ions and free electrons, and gives up these products impulsively. E. C. C. B.

1346. *Distribution and Spectra of Metallic Vapours in Electric Sparks.* **H. Ramage.** (Cambridge Phil. Soc., Proc. 12. pp. 350–353, April, 1904.)—In a previous paper [see Abstract No. 1184 (1903)] some peculiarities in the arc and spark spectra of lithium were described. For instance, the blue line was found to be broadened in the spectra of the regions near the negative element both in the arc and spark. In some further experiments upon the spark, two platinum wires were used as electrodes, and the anode was moistened with a solution of a lithium salt; in this case with the ordinary uncondensed discharge from an induction coil flashes of red were observed in the spark, and when the anode became heated the red colour became general throughout the whole spark, and the spectrum showed the red lithium line and the sodium lines. Evidently, therefore, the lithium was vaporised and reduced to the free state. A globule of lithium salt was then fused upon one of the wires, and with this as the anode the red flashes were more frequent and brighter, and at the same time the orange lithium line was faintly to be seen. With an air break in series no red colour was observed as long as the anode remained cold. On reversing the spark the red colour developed strongly in the flame near the kathode, but it only passed the whole way across the spark-gap in the case of very short sparks. Viewing the spectrum with the slit at right angles to the spark, the red line was seen as a long line, and the orange line as a short line, of medium intensity. The orange line is the strongest in the subordinate series, and is only seen in the axis of the spark. Where the spark touched the salt a very bright spot of light was seen, showing the two subordinate series very strongly. It was this bright spot which gave the broadened lines in the diffuse series mentioned in the previous paper. With a vertical spark and the salt bead on the upper electrode as kathode, the red colour only extended half the distance it did with the horizontal spark. On reversing the spark no red colour appeared until the head became heated, when the red colour extended to the clean kathode. With the bead on the lower electrode as kathode the red colour extended up to the anode, but was deepest near the kathode. With the bead as anode, again no colour appeared until the bead was heated. The lithium vapour liberated from the hot anode appears to carry a positive charge and carry a portion of charge to the kathode, but the lithium vapour from the kathode does not appear to be charged; if it is charged negatively at first, the charge must be quickly lost, as it certainly is not attracted by the anode. The lithium appears to be liberated in definite quantity by each spark. It is probable that the production of the subordinate series in the white spot on the kathode is associated with the liberation of the lithium atom by the action of the electricity at this point, that is to say, that the subordinate series are peculiar to the atom *in statu nascendi;* the principal series may thus be considered as due to the free atom. Somewhat similar results were obtained with sodium, potassium, rubidium, and cæsium, and with calcium, strontium, and barium. In an addendum it is noted that from observations of the sparks in a rotating mirror the coloured flames shoot out from the kathode. No colour was given to the spark in an atmosphere of hydrogen. [It would appear that these phenomena are very analogous to the curious results obtained a short time ago by Schenk, who, on viewing the condensed discharge between metal electrodes in a rotating mirror, noticed that metallic particles are shot off from the kathode and travel with a high initial velocity, which, however, rapidly decreases as the particles collide with the molecules of the surrounding atmosphere. In the case of magnesium Schenck [see Abstract No. 35 (1902)] obtained an initial velocity of 2·5 km. per sec. E. C. C. B.

1347. *Satellites of the Spectrum Lines of Cadmium.* **C. Fabry.** (Comptes Rendus, 138. pp. 854–856, April 5, 1904.)—It is well known that the green cadmium line has at least one satellite; Hamy has observed two satellites, and found that under certain conditions the three lines could appear of equal brightness. The author has confirmed these observations, and finds that the difference in wave-length between the centre line and the most refrangible is 0·0024 $\mu\mu$, and between the central line and the least refrangible lines is 0·0076 $\mu\mu$. Under certain conditions, however, only two of the lines, that is to say only one satellite, can be seen—the least refrangible. After some investigation it was found that the second satellite only appears when the cadmium vapour is absolutely pure. E. C. C. B.

1348. *Standards of Wave-lengths.* **H. Kayser.** (Astrophys. Journ. 19. pp. 157–161, April, 1904.)—After the publication of Rowland's standards of wave-lengths in the solar spectrum we seemed to have in hand the foundations for all future measurements, because even though the reference standard of the D_1 line taken by Rowland might be wrong, still it appeared as if an alteration in this would only necessitate the multiplication of all of Rowland's values by a constant factor; in other words, the relative values obtained by Rowland were considered as of absolute accuracy. This confidence was shaken when Michelson published the wave-lengths of the three cadmium lines, which not only differed from Rowland's values by about 0·2 tenth metre, but gave different relative values, as can be seen from the table:—

	λ	λ	λ
Michelson	6438·472	5085·824	4799·911
Rowland	6438·680	5086·001	4800·097
Difference	0·208	0·177	0·186

The differences are clearly not proportional to the wave-lengths. If the second line is relatively correct, then the two other differences should be 0·222 and 0·166, *i.e.*, the first line of Rowland is too small by 0·014, the third line too large by 0·020, while, according to Rowland, we should expect to find no errors greater than 0·005 tenth metre. When Fabry and Perot's measurements, made by an interference method and based on Michelson's value for the cadmium green line, appeared [see Abstract No. 675 (1902)], it was clear from the curve showing the relation between their values and those of Rowland that the latter are not anything like so correct as had generally been supposed, and indeed are not sufficiently accurate for present needs. The author long ago found errors in Rowland's work, and published a series of standard wave-lengths in the arc spectrum of iron, which have usually been used as reference standards. These, however, though more correct in detail, have the same general feature as Rowland's standards. It is evident, therefore, that better standards must be obtained, because if Fabry and Perot are correct in their measurements, as there is absolutely no reason to doubt, all measurements made up to this time with Rowland's standards must prove useless as far as wave-length is concerned. There are two sources of error in Rowland's work. First, Rowland did not know the difference between the position of solar and arc lines. Even the initial step of taking the solar D lines for the arc spectra was doubtful. The displacements observed in going from the solar to the arc spectra Rowland was convinced were due to a shifting of the apparatus, and they were always treated as being due to this cause. Rowland, in order to correct for this, shifted different parts of the spectrum to smaller or greater wave-lengths, and as from such parts other parts have been determined by the coincidence method, it is impossible to tell the extent to which the errors may have accumulated in different parts. These errors, however, could be avoided and a remeasurement of the standards carried out by the coincidence method, using Fabry and Perot's lines as a basis. The second source of error, however, is insurmountable, for it lies in the coincidence method itself. The author has tested both this method and at the same time Fabry and Perot's measurements. Two of Rowland's largest gratings, with 16,000 and 20,000 lines to the inch respectively, were used, and with the first grating, plates were taken containing Fabry and Perot's lines at λ = 5302 and λ = 5434, in the second order, coinciding with λ = 3550 to λ = 3630 in the third order. The wave-lengths of lines in the third order were then determined from the Fabry and Perot values. Again, plates were taken containing these lines in the fourth order, and also Fabry and Perot's lines at λ = 4736 and λ = 4859, in the third order, so that their wave-lengths could be determined. In this way the value 4736·804 was obtained as against Fabry and Perot's value of 4736·785. This difference of 0·019 shows that either Fabry and Perot's values are relatively wrong or that the coincidence method is valueless. The second grating was then used in an exactly similar series of measurements with the result that a difference of

0·108 was obtained, still greater than in the first case. The two gratings were then compared directly together. With each grating two plates were procured of the region $\lambda = 5302$ to $\lambda = 5434$ in the second order, and the lines of the third order measured in each. The following values were obtained :—

Grating with 20,000 lines.			Grating with 16,000 lines.			Difference.
First Plate.	Second Plate.	Mean.	First Plate.	Second Plate.	Mean.	
3541·068	0·069	0·069	0·103	0·101	0·102	0·033
3553·716	0·719	0·718	0·756	0·751	0·754	0·036
3558·494	0·493	0·494	0·532	0·531	0·532	0·038
3565·356	0·361	0·359	0·396	0·393	0·395	0·036
3570·078	0·082	0·080	0·117	0·113	0·115	0·035
3586·966	0·965	0·966	0·003	0·002	0·003	0·037
3606·667	0·663	0·665	0·697	0·696	0·697	0·032
3608·845	0·841	0·843	0·879	0·876	0·878	0·035
3617·782	0·778	0·780	0·805	0·809	0·807	0·027
3621·452	0·447	0·450	0·478	0·477	0·478	0·028
3621·996	0·991	0·994	0·019	0·019	0·019	0·026

By the difference of 0·03 tenth metre it is evident that the two gratings give different results and that they both are not to be used for the coincidence method. There is therefore no reason to doubt the accuracy of Fabry and Perot's values. There may, perhaps, exist gratings free from this fault, but every one must be carefully tested before using. The only hope we have, therefore, lies in the determination of a number of lines in the ultra-violet by the interference method, between which other lines could then be interpolated from concave grating photographs. [It is difficult to overestimate the importance of the results given by the author in this paper. As he himself points out, all the determinations of wave-lengths are rendered practically useless, and at the same time we are deprived of an accurate standard of reference and the principal method of experiment. It is quite probable that herein also lies the explanation of the different values obtained for the same lines by different observers, although the accuracy of experiment in each case was very much higher than these differences. Again, in working by the coincidence method, the same lines appear to have different wave-lengths according to the "route" by which they were arrived at; no doubt this is also due to the same cause.] E. C. C. B.

1349. *Spectra from the Wehnelt Interrupter.* **H. W. Morse.** (Amer. Acad., Proc. 39. No. 21. pp. 519–544, May, 1904. Astrophys. Journ. 19. pp. 162–186, April 1904. Jefferson Phys. Lab., Harvard University.)—An account of the first part of an investigation into the spectra produced by a Wehnelt interrupter when different metals are used for the active point and different salts as electrolytes. A great number of metals were tried, and some very interesting results obtained. The spectra show a certain similarity to those produced when sparks pass from a platinum wire to solutions of metallic salts. The first series of observations showed that the spectrum is the same whether the metal in question is used as the active electrode or is present as a salt in solution, or whether the metallic point is anode or kathode. The

spectrum is the same whether a direct- or alternating-current is used, and therefore in these experiments the alternating-current was employed, as the heating effect is considerably less in this case. Tables of wave-lengths, and plates, are given of the spectra, and the following may be mentioned as being the most important of the results obtained. The Wehnelt spectra include some lines which are usually attributed to the spark spectrum and some which are attributed to the arc spectrum; usually the spectrum is closely allied to that produced in the spark, but often some of the strongest lines are wanting. This tends to the conclusion that there is no sharp line of demarcation between arc and spark spectra, but that the change is continuous. Under constant conditions the spectrum may contain the strongest lines of the condensed spark and at the same time lines usually ascribed to the flame; the "oxide bands" may also be seen at the same time as the strong spark lines. In the case of zinc and tin, new band spectra were observed at the same time as the spark and arc lines of these metals. Certain lines which are broad and diffuse in the spark and are absent in the arc are present in the Wehnelt spectrum, but much decreased in intensity. At first sight these results look as if in the case of the Wehnelt spectrum we were dealing with the entire series of temperatures, from that sufficient to give the band spectrum of a compound to that necessary to produce the strongest lines of the spark spectrum of metals like platinum and chromium. But in no case are all the lines of the various spectra to be observed, so that the above conclusion is not justified. The author considers that there must be a considerable temperature variation during each interruption in the Wehnelt, and that there must also be a similar variation in the spark in air. Probably all three spectra (arc, spark, and Wehnelt) are composites, though this is not so evident in the first two cases. It is remarkable that no reversals were seen in the spectra with the Wehnelt, although these have been seen in the case of the arc under water.
E. C. C. B.

1350. *Coefficient of Diffusion of the Emanation of Radium.* **P. Curie** and **J. Danne.** (Comptes Rendus, 136. pp. 1314–1316, June 2, 1903.)—The authors have measured the coefficient of diffusion of radium emanation into air, and find that at atmospheric pressure and at about 10° C. its value is 0·1 c.g.s. unit. This number is in accordance with that obtained by Rutherford and Miss Brooks, which was about 0·05. In other circumstances also the emanation is found to behave like a gas. The authors have repeated Rutherford's experiment of the condensation of the emanation at the temperature of liquid air.
J. J. S.

1351. *Radio-active Lead.* **A. Korn** and **E. Strauss.** (Ann. d. Physik, 11. 2. pp. 397–404, May 14, 1903. Comptes Rendus, 136. pp. 1312–1313, June 2, 1903.)—It has been found that an increase in the photographic action of preparations of radio-active lead is caused by exposing these preparations for some time to kathode rays. The authors distinguish two effects in their radio-active preparations: (1) the dissemination of a fine material substance in the surrounding air, (2) a radiation sent out by the radio-active substance. The first has no penetrating power, is very slightly or not at all affected by a strong magnetic field, and is not strengthened by the kathode rays. The second is very penetrating, is deviated in a strong magnetic field, and is strengthened by the kathode rays. By chemical treatment of a specimen of radio-active lead a preparation was obtained whose penetrating photographic action was not weakened, whilst its capacity for discharging electricity was considerably diminished. In another case it was observed that the capability of causing dissipation of electricity was increased by chemical manipulation, the photographic action remaining unchanged. J. J. S.

1352. *A Property of the α-rays of Radium.* **H. Becquerel.** (Comptes Rendus, 136. pp. 1517–1522, June 22, 1903.)—An account of experiments on the deviation of the α-rays in a magnetic field, and a discussion of theoretical considerations. The experiments show that in a uniform magnetic field the radius of curvature of the trajectory of the α-rays deviated by the field goes on increasing with the length of the trajectory. Experiments carried out in a vacuum by Des Coudres indicate the influence of the air on the trajectory. It might be concluded that $\frac{m}{e}$ is constant, and that the velocity goes on increasing, but it appears difficult to admit *a priori* an augmentation of the velocity without m and e undergoing variations. If m is supposed to be a material mass it may increase by collecting, on its passage, ions from the air, and the increase of the radius of curvature may be explained by an augmentation of the mass. In the α-rays the mass m is positive; it would thus attract negative ions, and the charge e would diminish. A part at least of the effect which produces an increase of the radius of curvature of the trajectory may be attributed to a diminution of the charge. Or, as Kaufmann supposes, the mass m may be taken as a purely electromagnetic magnitude, a function of v and of e, and without bringing in material masses it may be considered that the positive charge e attracts negative electrons from the air, and that it diminishes along the trajectory. The same fact is expressed by saying that the charge dissipates progressively in air rendered conducting by the passage of the α-rays. J. J. S.

1353. *Effect of Extreme Cold on the Emanations of Radium.* **W. Crookes** and **J. Dewar.** (Roy. Soc., Proc. 72. pp. 69–71, July 31, 1903.)—The authors, in examining the effect of extreme cold on the action of radium, first tried whether the scintillations produced on a blende screen were affected by the cold. A small screen and a fragment of radium in front were sealed in a glass tube with a lens in front. On dipping the whole into liquid air the scintillations grew fainter and finally ceased. To test whether this was due to the presence of liquid, loss of sensitiveness of the screen, or the ceasing of the ion-emission, two tubes were employed, in one of which the radium salt could be cooled and not the screen, and in the other the screen and not the radium. With the first tube in liquid air the scintillations were quite as vigorous as at the ordinary temperature. In the second case, as the screen was cooled in liquid air the scintillations became weaker and finally ceased, reappearing when the temperature was allowed to rise. Other experiments were tried which showed that the highest vacuum obtainable by the action of cold does not diminish the scintillations. The ionising effect of the radium was found to be unaffected by being plunged into liquid hydrogen after having been first heated to a high temperature and the highest vacuum possible produced in the tube, but the luminosity of the radium salt in liquid hydrogen was more marked than had been observed with the former salts containing barium in large quantity. An experiment was also made to find out the behaviour of anhydrous radium bromide in the highest vacuum with reference to the condensible emanation of Rutherford and Soddy [see Abstract No. 95 (1904)]. For this purpose the radium salt was placed in the bottom of a glass bulb connected to a capillary tube with a plug of purified asbestos between. The whole was heated, exhausted to the limit of the mercury pump and sealed off. In the dark no phosphorescence could be observed except from the radium itself. The capillary was then placed in liquid air in a large flask so that distillation might go on for some days. After 24 hours a marked phosphorescence in the capillary was observed, owing to the condensed emanation, and the phosphorescence became more marked the longer the action proceeded. The authors intend to continue the experiments for a lengthened period of time. L. H. W.

1354. *Radio-active Emanation in Water and Oil Springs.* **F. Himstedt.** (Ann. d. Physik, 12. 1. pp. 107–123, July 21, 1903, and 13. 3. pp. 573–582, Feb., 1904. From the Ber. d. Naturf. Ges. Freiburg, 13. p. 101 and 14. p. 181, 1903.)—All deep-spring water contains radio-active emanations; no river water does. Hot springs contain more than cold; all cold springs are about equal to one another, and 50 litres of air will have the conductivity increased 40-fold by being driven through ¾ litre water. Crude rock-oil can wash the emanations out of air charged with them, and all fresh crude oil is highly charged with them. An inactive liquid kept in cellar-air becomes active. The emanations seem to follow Henry's law as to their solution in liquids, and are lost or gained by a liquid to or from the surrounding air until equilibrium is reached; if brought into relatively active air the liquid may appear negatively active, reducing the conductivity of the air. A run of 100 m. in the open air is enough to discharge active spring water of its emanations. The emanations appear identical with those from radium, condensing at —147° to —154°, showing the same relative solubilities in different liquids, &c.; the emanations perceptibly produce scintillations in sidote blende; and they disappear from confined air or liquid in the same way. A. D.

1355. *Action of Magnetic Fields on Feeble Luminous Sources.* **C. Gutton.** (Comptes Rendus, 138. pp. 268–270, Feb. 1, 1904.)—The author finds that every time a screen of phosphorescent sulphide of calcium is placed in a magnetic field which is not uniform it becomes more visible. A uniform field has no action. Lead and black paper were interposed to keep off *n*-rays or heat rays, and the experiments showed great sensitiveness to the action observed. J. J. S.

1356. *Action of a Magnetic Field on Phosphorescent Substances.* **C. Gutton.** (Comptes Rendus, 138. pp. 568–569, Feb. 29, 1904.)—The author has previously shown that a non-uniform magnetic field increased the phosphorescence of a calcium sulphide screen [see preceding Abstract], and he now examines the effect of a uniform field of varying intensity. He finds that the same effect is produced by varying the field slowly within certain limits. On quickly closing or opening the magnetising circuit no increase of phosphorescence is observed, there being a certain duration necessary for the effect to be produced. The variations in the field are held to produce induced e.m.f.'s in the sulphide, for with a constant strength of field the effect may be produced also by displacing the magnetising coil, leaving the screen fixed. Any displacement of the bobbin perpendicular to its axis will make the magnetic lines cut the screen, any movement parallel to the axis will not do so, and the latter movement has no action on the phosphorescence. A similar effect is produced by magnets in motion. L. H. W.

1357. *Action of Magnetism on Phosphorescence.* **A. de Hemptinne.** (Comptes Rendus, 138. pp. 754–755, March 21, 1904.)—The author, referring to Gutton's experiments with a variable magnetic field [see preceding Abstract], points out that in 1900 he proved that a uniform field up to 25,000 units had no effect on the phosphorescence (Bull. Acad. Belg., 1900), but he did not try the effect of a varying field. He now describes an experiment after the method of Gutton. This gave a negative result. The chief difference between the author's and Gutton's calcium sulphide was that the former gave a yellow-green phosphorescence, whilst that of the latter was violet. He therefore considers that the phosphorescent substance to show this effect may require to have certain special, as yet unknown, properties.

L. H. W.

1358. *Action of Certain Chemical and Osmotic Phenomena on Phosphorescence.* **Lambert.** (Comptes Rendus, 138. pp. 626–627, March 7, 1904.)—The author points out that the effect noticed by Jégou [see Abstract No. 1075 (1904)] when the circuit of a Leclanché cell was closed, can be produced even on open circuit in the case of a bichromate cell, in which there is chemical action on open circuit. An effect on a phosphorescent screen is also produced by the proximity of osmotic phenomena, such as two solutions of different osmotic pressures, separated by a parchment membrane, or even two solutions of different concentration of the same electrolyte, with a diaphragm between. The use of a solution of 0·7 per cent. of common salt in water contained in a parchment bag is said to give good results. On plunging this into a more concentrated salt solution the screen glows.

L. H. W.

1359. *Physiological Action of Blondlot's* N_1*-rays.* **A. Charpentier.** (Comptes Rendus, 138. pp. 648–649, March 7, 1904.)—The author confirms Blondlot's observation of the emission from various substances of n_1-rays which diminish phosphorescence. [See Abstract No. 1038 (1904).] In certain forms of strong muscular contraction he finds that enfeeblement of the phosphorescence of a screen is produced. Moreover, the n_1-rays produce on the nervous system effects which are inverse to those of the positive rays. For example, they produce diminution of the olfactory sensation.

J. J. S.

1360. *Disappearance of Induced Radio-activity after Heating.* **P. Curie** and **J. Danne.** (Comptes Rendus, 138. pp. 748–751, March 21, 1904.)—When heated to a high temperature a solid body (such as a sheet of platinum) which has gained radio-activity from the emanation of radium, loses its activity much more rapidly that when at the surrounding temperature. The activity is transported to neighbouring bodies [see Abstract No. 1067 (1904)]. The law of the disappearance of activity of sheets of platinum first activated by radium and then heated to high temperatures was studied at the surrounding temperature. The behaviour of the platinum is expressed by means of curves. A simple exponential law of deactivation was found when the platinum was heated above 630°. The law of deactivation of bodies which have gained activity from the neighbourhood of the platinum deactivated by heating was also studied. The law in this case is not a simple exponential one. The activity even passes through a maximum. The hypothesis previously mentioned by the authors [see Abstract No. 1085 (1904)] is applied to explain some of these phenomena. The experiments show that the nature of the radio-activity induced on a sheet may be modified by variations of temperature.

J. J. S.

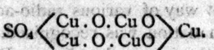
1361. *Selective Physiological Action on Phosphorescent Screens.* **A. Charpentier.** (Comptes Rendus, 138. pp. 772–774, March 21, 1904.)—Most of the alkaloids and many other toxic substances such as chloral emit *n*-rays in considerable quantity. Moreover, their action on the phosphorescent screen is reinforced by the presence of another source of *n*-rays in their neighbourhood. An action analogous to resonance occurs, the effect of the two sources acting together being greater than the sum of their separate actions. Screens have been formed consisting of an area covered with a thick layer of alkaloid with a patch of phosphorescent sulphide in the centre. A selective action is observed with such screens, that is, they are more influenced by certain organs of the body than by others. Thus the apparent relative emission from different organs depends on the alkaloid used in the screen. The organ which modifies the phosphorescence most is that which manifests the strongest affinity for the alkaloid employed, that is, it is the organ on which the toxic action of that alkaloid especially localises itself in physiological experiment. For example, digitaline which selectively affects the heart's action, when used in a screen, shows the contours of that organ more clearly than a simple screen. Many other examples are given. J. J. S.

1362. *Radio-activity of Certain Minerals and Mineral Waters.* **R. J. Strutt.** (Roy. Soc., Proc. 73. pp. 191–197, March 23, 1904.)—The radio-active constituents of various radio-active minerals were determined by the method of heating the crude mineral and examining the rate of decay of the emanation which it gives off. Each emanation has a characteristic time-constant of decay, and by determining this it can be identified. The results of the examination in this way of various radio-active minerals are given in the paper. No new emanation was recognised. The effects were in all cases found to be due to thorium and radium. Deposits obtained from the mineral springs in Bath and in Buxton were tested by the same method, and the activity was shown to be wholly due to radium. J. J. S.

1363. *Emission of* N_1*-rays in Inhibitory Phenomena.* **A. Charpentier** and **E. Meyer.** (Comptes Rendus, 138. pp. 832–833, March 28, 1904.)—In a previous paper the author described the diminished brilliancy of the phosphorescent screen when the heart is arrested by stimulation of the vagus nerve. [See Abstract No. 1044 (1904).] This persists so long as stimulation is continued, even though the heart begins to beat again. A similar effect on the screen is produced by the use of a feeble current such as is insufficient to arrest the heart. It follows from these facts that the loss of brilliancy is not due to the diminished activity of the heart. Observations seem to show that the inhibitory phenomena are accompanied by the emission of n_1-rays, for at the moment of inhibition the brightness of the screen is diminished as compared with its neutral condition, and not only as compared with its exalted brilliancy produced by the activity of the heart. Thus, if the screen is not approached to the heart until inhibition has been already effected, it is seen to at once become dulled. A similar result is obtained by respiratory arrest provoked by stimulation of the vagus, the screen being placed in the neighbourhood of the medulla oblongata. H. W. P. Y.

1364. *Presence of Radio-active Matter in Ordinary Substances.* **J. J. Thomson.** (Cambridge Phil. Soc., Proc. 12. pp. 391–397, April, 1904.)—A radio-active emanation was obtained from the water of various wells in different parts of the country. Different solid substances when tested were found to give off the emanation; it was produced by practically all the clays, sands, and gravels examined. This emanation is the same as that given out by radium, the phenomena being such as would occur if radium were a very widely diffused substance. The emanation obtained from the substances tested (for example, clay, sand, or shale) is due to an impurity mixed with them and does not come from the main bulk of the substance. Though the property of giving off an *emanation* does not appear to be at all general, the author concludes from the evidence obtained that most if not all bodies are continually emitting radiation which, like the Röntgen rays, can ionise a gas through which it is passed. Consideration of the facts observed in the case of the ionisation of gases in closed vessels and the action of different screens, supports this view. J. J. S.

1365. *Application of the Blondlot Rays to Chemistry.* **A. Colson.** (Comptes Rendus, 138. pp. 902–904, April 11, 1904.)—The addition of a solution of potassium hydroxide to one of zinc sulphate causes a diminution in the brilliancy of phosphorescent sulphur in the neighbourhood, owing to the generation of n_1-rays; these rays disappear, however, before sufficient potassium hydroxide is added to precipitate all the zinc, and do not reappear on further addition of the alkali. If the zinc sulphate solution is poured into that of the potassium hydroxide, no n_1-ray effects are observed. Investigation leads to the conclusion that the formation of the n_1-rays depends on that of the basic salt, $SO_4(ZnO\,.\,ZnOH)_2$. The same phenomenon is observed with copper sulphate solution, the rays appearing when 1 mol. of KOH is added to $\frac{1}{2}$ mol. of $CuSO_4$ in dilute solutions; the basic salt, in this case, has the composition



$$SO_4\left\langle\begin{matrix}Cu\,.\,O\,.\,Cu\,O\\Cu\,.\,O\,.\,CuO\end{matrix}\right\rangle Cu.$$

The molecular condensation taking place in the formation of these compounds hence acts similarly to mechanical pressure. [See also Jégou, Abstract No. 1075 (1904).] T. H. P.

1366. *Action of Hertzian Oscillations on Slightly Luminous Sources.* **C. Gutton.** (Comptes Rendus, 138. pp. 963–965, April 18, 1904.)—The author has already shown that a variable magnetic field produces an augmentation of the light from phosphorescent material, due in the author's opinion to induced e.m.f.'s. [See Abstract No. 1356 (1904).] He now describes experiments with Hertzian oscillations, since intense e.m.f.'s are produced round a Hertzian oscillator. The oscillations were produced by a small Blondlot oscillator from which they were led by wires 9 m. long to antennæ 4 cm. in length, placed in the focus of a cylindrical parabolic reflector, from whence they were reflected and then received by a similar mirror concentrating them upon the screen used, the mirrors being 1 m. apart. The gap and mirrors were in separate enclosures to prevent any action due to the noise of the spark [de Lépinay, Abstract No. 761 (1904)], and a Holtz machine was used as an exciter to avoid the use of a coil which would produce a variable magnetic field. The action was found to be similar and more powerful than that before observed with a varying field. A wire grating was interposed and reduced the effect to a minimum when the wires were parallel to the direction of electric force, and a maximum was observed at right angles to this. A metal screen interposed between the mirrors cut off all action, whilst a cardboard screen had no effect. The author considers that the use of a phosphorescent screen provides an easy means of observing reflection and polarisation of electric waves, in place of the resonator. L. H. W.

1367. *Action of the Rays from Radium on the Sense of Sight.* **E. S. London.** (Archives d'Él. Médicale, 12. pp. 258–269, April 10, and pp. 298–307, April 25, 1904.)—Radium rays provoke the sensation of light by acting on the retina and probably by inducing fluorescence of some portion of this organ. These rays and luminous rays offer no analogy from the point of view of their physiological action on the visual apparatus. Although the rays from radium are neither reflected nor refracted by the ocular media, yet they are to some extent absorbed by them. In the case of a man in whom the crystalline lens had been removed from one eye, the eye received a markedly stronger luminous sensation than the normal eye when a specimen of radium was brought near it. After some practice the subjects of the experiments were able to distinguish the movement of the rays and to recognise simple figures traced by it in space. The fluorescence of a platinocyanide screen produced by radium is perceived by blind persons who possess some portion of the retina as yet undamaged by optic atrophy. By fixing black bands to represent various figures and letters on to the fluorescent screen the author is able to teach such blind persons, whose affliction commenced during infancy, to recognise the various letters, &c., and thus to gain a mental visual impression which assisted them greatly in reading with the fingers. By a sufficiently intense and prolonged action on the eye radium induces inflammatory conditions such as keratitis, retinitis, and ocular atrophy. The rays do not increase the visual faculty. It is probable that the radium rays may act directly on the central visual apparatus.
H. W. P. Y.

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1368. *Focometer.* **A. Champigny.** (Soc. Franç. Phys., Séances, 3. pp. 220–226, 1903.)—Description of a simple and economical apparatus for measuring focal lengths, radii of curvature, ascertaining focal planes, nodal points, &c. A. D.

1369. *Index of Refraction of Liquids by Arago's Wedge Compensator.* **J. Wallot.** (Ann. d. Physik, 11. 2. pp. 355–396, May 14, 1903. Extract of Munich Inaugural Dissertation. Physik. Institut. d. Universität.)—The theory of the apparatus is first described, and then the arrangement. Tests are made with distilled water and saline solutions of different concentrations. Temperature effect is considered. The uses and comparative advantages of this form of compensator are discussed.
J. W. P.

1370. *Consequences of Lambert's Law of Radiation.* **A. Schmidt.** (Phys. Zeitschr. 4. pp. 453–456, May 15, 1903.)—Consideration of the above law in connection with results obtained by Seeliger [see Abstract No. 270 (1904)] and the author [see next Abstract] on the question whether the diminution of intensity is due to refraction or to absorption. G. E. A.

1371. *Observation of Intensity Diminution by Refraction.* **A. Schmidt.** (Phys. Zeitschr. 5. pp. 67–69, Feb. 1, 1904.)—Observations described which support the author's views. [See preceding Abstract.] G. E. A.

1372. *Physical Basis of Colour.* **C. A. Chant.** (Science, 17. pp. 864–868, May 29, 1903.)—The considerations which lead to colour being regarded as a function of wave-length are here put forward. The view of Kirschmann, that mixture is necessary, is opposed. The latter regards the problem from the point of view of the large difference of frequency in passing across a small part of the spectrum; but the need for much fuller physical consideration (especially in regard to the sensitiveness of the eye) is here pointed out. J. W. P.

1373. *Inertia of the Retina.* **A. Broca** and **D. Sulzer.** (Comptes Rendus, 136. pp. 1287–1290, May 25, 1903.)—The data work out differently according to the criterion which is adopted, and where for a clear vision of 7 white strips with 6 intervening black ones ⅛ sec. is necessary, for a mere glimpse of something visible occurring, say, once out of five times, the necessary period is 0·0035 sec. If we take the former of these as the criterion, we find that the brightness must be greater the greater the retinal distance from the point of fixation, about 1 to 5 within a visual angle of 13°. The process of clear discrimination of the markings spreads over the retina from the point of fixation with a velocity of about 0·25 mm. per sec.; and as to what this process may be, it would seem that the nervous cellules of the retina have to establish mutual connections as required, and that for this a certain amount of energy is required, and the point of fixation is the starting-point of the process. [For later papers see Abstracts Nos. 517, 518, 519 (1904).] A. D.

1374. *Anomalous Dispersion of Metallic Vapours.* **H. Ebert.** (Phys. Zeitschr. 4. pp. 473–476, June 1, 1903.)—A demonstration of the above is obtained by passing light through a furnace in which the metallic vapour is blown into prismatic shape by two blasts of hydrogen gas. The behaviour of potassium is described. G. E. A.

1375. *Brightness of the Sun's Disc.* **A. Schmidt.** (Phys. Zeitschr. 4. pp. 476–479, June 1, 1903.)—Discussion of the question of diminution of the intensity of light from the sun's disc from middle to edge, its cause being set down as refraction alone, and the law of diminution being of the form $H = H_0 \cos^2 a / \cos^2 \beta$. [See Abstract No. 1340 (1903).] G. E. A.

1376. *Skew Refraction through a Lens.* **J. D. Everett.** (Roy. Soc., Proc. 71. pp. 509–522, June 4, 1903.)—This gives a mathematical treatment of the problem of the hollow pencil given by the annulus of a lens placed at an obliquity of about 45° to the incident rays. Twelve points 30° apart are taken on the annulus as points of incidence, and the direction cosines of the emergent rays are calculated. The axis of the lens is taken as axis of z, the axis of y being in and the axis of x perpendicular to the plane of symmetry, and from the equations of the emergent rays thus referred to, the curve of section of the pencil by a plane is found. Illustrative diagrams for the mathematical treatment are given. J. W. P.

1377. *Quartz as a Standard Reflector.* **J. Koenigsberger.** (Phys. Zeitschr. 4. pp. 494–495, June 15, 1903. Physik. Institut. Freiburg.)—Different reflectors are considered, and the theoretical results of Fresnel and Neumann compared with Rayleigh's investigation. A comparison is made of results of the author upon quartz plates, and it is concluded that this substance, on account of good agreement between different pieces and between theory and experiment, may be taken as a convenient standard. J. W. P.

1378. *Limits of Unaided Vision.* **H. D. Curtis.** (Science, 17. pp. 1010–1011, June 26, 1903.)—The sixth stellar magnitude is about the limit of naked eye vision. Shading off the faint light of the sky, the author was able to see stars down to the 8th magnitude, and with difficulty down to 8·5. A. D.

1379. *Ultra-Microscopic Objects.* **A. Cotton** and **H. Mouton.** (Comptes Rendus, 136. pp. 1657–1659, June 29, 1903.)—Description of arrangement for observing ultra-microscopic objects. J. W. P.

1380. *Absorption of Actinic Rays by Glass.* **A. Pflüger.** (Ann. d. Physik, 11. 3. pp. 561–569, June 4, 1903. Physik. Inst. d. Univ. Bonn, March 20, 1903.)—By means of a thermopile the absorptive power of eight kinds of crown and flint glass supplied by Schott are measured between wave-lengths 357 $\mu\mu$ and 640 $\mu\mu$ of the spectrum of a Nernst or arc lamp. The optical part of the apparatus includes four glass lenses and a quartz prism, and the results show strong absorption beginning at about $\lambda = 420\ \mu\mu$. G. E. A.

1381. *Magnetism of Liquids and Crystals.* **G. Meslin.** (Comptes Rendus, 136. pp. 1305–1308, June 2, 1903.)—The phenomenon studied [see Abstracts Nos. 68 and 740 (1904)] consists in an unequal modification which the principal components of light undergo when passing through certain liquids in a magnetic or electric field. It is connected with refractions and reflections produced by the oriented lamellæ, and is not, strictly speaking, caused by absorption; thus the terms magnetic or electric dichroism do not exactly characterise the phenomenon. The phenomena are magneto-crystalline. The active liquids always consist of a liquid associated with a crystalline solid. The author gives some further particulars of various liquids which he has investigated. No body belonging to the cubical system is found amongst the active substances, but all the other crystalline systems are represented. J. J. S.

1382. *Absorption and Reflection by Metallic Sulphides and Oxides.* **J. Koenigsberger.** (Phys. Zeitschr. 4. pp. 495–499, June 15, 1903. Physik. Institut. Freiburg.)—These substances show continuous absorption. The indices of refraction calculated from the experimental data are high. Comparison with Maxwell's theoretical results is made. J. W. P.

1383. *Velocity of Light in Calcspath under Stress.* **F. Pockels.** (Ann. d. Physik, 11. 4. pp. 726–753, June 22, 1903.)—This continues the work referred to in Abstract No. 2029 (1902). Similar investigations are here made upon calcspath; a mathematical consideration is first given, and then the measurements on a variety of prisms are described. J. W. P.

1384. *Spontaneous Dichroism of Liquid Mixtures.* **G. Meslin.** (Comptes Rendus, 136. pp. 1641–1643, June 29, 1903.)—Dichroism (partial polarisation of light by the liquid) is found to be produced by very weak magnetic fields and by gravity alone. A table of liquid mixtures (carbonate of potash and petrol, boric acid and benzine, &c.) is given, with the effect in each case. [See also Abstracts Nos. 68 and 740 (1904).] J. W. P.

1385. *New Method in Focometry.* **C. Féry.** (Soc. Franç. Phys., Séances, 3. pp. 226–231, 1903.)—This gives an account of a method by which the focal length, &c., of a lens may be determined. The lens is displaced through an accurately measured distance perpendicular to its principal axis, and the angle of deviation of the ray, which formerly was centric, is measured. The focal length is given by $d/\tan \alpha$, where d is the distance and α the angle referred to above. A description of the actual apparatus is given. To obtain an accuracy of 1 in 1,000 in the measurement of the focal length, d must be measured to 0·01 mm. and α to 10″. J. W. P.

1386. *Relation between the Optical and Electrical Properties of Metals.* **E. Hagen** and **H. Rubens.** (Annal. Chim. Phys. 1. pp. 185–214, Feb., 1904.)—A compilation giving the results of all their recent work as shown chiefly in Abstracts Nos. 1049 (1902) and 62, 63, and 64 (1904). G. E. A.

1387. *Position of Optic Axes of Liquids under Stress.* **C. Zakrzewski.** (Acad. Sci. Cracovie, Bull. 1. pp. 50–56, Jan., 1904. Laboratoire de Physique de l'Université de Cracovie.)—The liquid is placed between two vertical cylinders, of which the inner can be rotated, and the observations are made by two nicols parallel to the axis of the cylinders. Collodion, olive oil, and paraffin oil are examined. The connection between the additional rotation of the nicol and the speed of the cylinder is determined. J. W. P.

1388. *Effect of Non-Parallelism of Axes of Binocular.* **F. J. Cheshire.** (British Optical Journ. 3. pp. 112–113, Jan., 1904.)—When the axes of the two telescopes of a binocular, instead of being parallel, have a small inclination a, rays from a distant point will emerge at an inclination $(M - 1)\,a$, where M denotes the angular magnification of the instrument. This is the angle at which the observer's eyes must be inclined for single vision of the object. Inclinations exceeding $1\frac{1}{2}$° strain the eyes, unless the inclination is convergence. If the axes of the binocular are convergent, the axes of the eyes must be divergent. A. E.

1389. *The "Verant."* **E. Wandersleb.** (Deutsch. Phys. Gesell., Verh. 6. 1. pp. 44–60, Jan. 15, 1904.)—Apparatus by M. von Rohr for viewing photographs at a distance, which enables the centre of rotation of the eyeball to act as the apex of the cone determining the visual angle. Lens-combination devised to give good images in whichever direction the eye, properly placed, is turned. Perspective discussed; the lens looking at the photograph is equivalent to the eyepiece of a telescope looking at the aerial image, which latter is what a photograph records; and the effects of distance, foreshortening under narrow angles, &c., are the same as with a telescope. Modifications for stereoscopic use. A. D.

1390. *Principle of Optical Apparatus with very Great Enlargement.* **C. Chabrié.** (Comptes Rendus, 138. pp. 265–268, Feb. 1, 1904.)—The author proposes to obtain very great enlargement, at the expense of distortion of the image, by placing the object in front of the apex of a transparent cone, refraction through which is such that the smaller the object (supposed circular) the greater is the enlargement along the circumference of the image. G. E. A.

1391. *Circumferentor.* **H. Grubb.** (Roy. Dublin Soc., Proc. 10. 14. pp. 143–145, Feb. 10, 1904.)—Surveying instrument for rapid measurement of horizontal and vertical angles. The eye, directed towards a piece of plane glass covered with a film of sulphide of lead, sees the landscape through it, and also, reflected from it and apparently coincident with the landscape, the image of a transparent circumferential scale of degrees and tenths of degrees. There is no parallax; the degrees as measured correspond to true angular values on the horizon, and both landscape and scale are equally affected by any error in the mechanical fitting. A. D.

1392. *Optical Measurement of Differences of Thickness.* **A. Perot** and **C. Fabry.** (Comptes Rendus, 138. pp. 676–678, March 14, 1904.)—Where light passes successively normally through two semi-silvered plates of glass L and L′, of thicknesses E and E′, and a compensating thin slip or rider l of thickness e, if $E' + e = nE$, where n is a whole number, there is no difference of phase between the light which has (1) been twice reflected in L and then traversed L′ and l and that which has (2) traversed L and been twice reflected both in L′ and in l; and where the thickness of l is e there is a white band, with coloured bands on each side of it. If the rider be graduated beforehand it is easy to find the difference between the two thicknesses E and E′ if their ratio to one another be approximately known. A. D.

1393. *Magnification by a Glass Cone.* **C. Chabrié.** (Comptes Rendus, 138. pp. 349–351, Feb. 8, and pp. 560–563, Feb. 29, 1904.)—The first paper discusses the image which a glass cone with flat base gives of a small disc towards which its vertex is directed, the disc being coaxal with the cone. The image is a ring, and the tangential magnification Y for distance x from the centre of the disc is $Y=\frac{R}{x}-\frac{R-r}{\rho}$, where R, r are the bounding radii of the ring, and ρ that of the disc. The second paper gives illustrations of the appearances obtained by using an eyepiece composed of two such cones instead of the ordinary eyepiece of a microscope.
A. E.

1394. *Electrical Resonance of Metal Particles for Light Waves.* **F. Pockels.** (Phys. Zeitschr. 5. pp. 152–156, March 15, 1904.)—A mathematical consideration of the hypothesis of electrical resonance to explain the brilliant colours of films made up of fine metal particles. The observations of Ehrenhaft and the theoretical treatment of Thomson are considered. [See Abstracts Nos. 275 and 741 (1904).]
J. W. P.

1395. *Development in Daylight.* **A.** and **L. Lumière** and **A. Seyewetz.** Photographic Journ. 44. pp. 103–104, March, 1904. (Abstract from Bull. Soc. Franç. 2. 20. p. 103.)—The authors, after discussing the use of coxin for this purpose, refer to the use of colouring materials to be added to the developer, which do not stain the film. They prefer magnesium picrate, and formulæ are given for use under various conditions and with different developers. [See also Abstract No. 529 (1904).]
L. H. W.

1396. *Optical Properties of Vitreous Silica.* **J. W. Gifford** and **W. A. Shenstone.** (Roy. Soc., Proc. 73. pp. 201–208, March 23, 1904.)—Vitreous silica is suitable for a standard glass on account of its definite composition. It is as transparent to ultra-violet rays as quartz, but is not doubly refractive. Its refractive index is low, being 1·4584772 for the D line, and its dispersive power is greater than that of quartz. Five prisms, from one of which measurements of the refractive index were made, were in general indistinguishable as regards behaviour on the spectrometer, although made from separate meltings. A table of the proportional dispersions of fluorite, quartz, and vitreous silica is given. [See also Abstract No. 207 (1903).]
G. E. A.

1397. *Photographic Reversal under the Combined Action of Various Radiations.* **C. E. S. Phillips.** (Röntgen Ray, Archives, 8. pp. 198–202; Discussion, pp. 202–207, April, 1904. Paper read before the Röntgen Society, Dec. 3, 1903.)—Solarisation generally occurs first at places of maximum photographic action, and also takes place under the action of red light in certain cases. With Röntgen rays alone the phenomena of solarisation are absent, although a plate reverses when exposed first to Röntgen rays and then to white light. The action of the Minchin photo-electric cell is discussed as a means of observing the behaviour of light-sensitive materials when acted upon by various radiations. In the *discussion*, experiences of photographic reversal are related. [See also Abstract No. 1001 (1904).]
G. E. A.

1398. *Polarimeters and Saccharimeters.* **P. Pellin.** (Journ. de Physique, 2. pp. 436–442, June, 1903.)—An account of these instruments under three heads: (1) Those in which the zero and the observation point are characterised by the same phenomenon occupying the whole field; (2) those in which the two points are characterised by the equality of two or several phenomena occupying juxtaposed fields; (3) those characterised by concentric fields. The instruments of Biot, Mitcherlisch, Wild, Soleil, Senarmont, Cornu and Duboscq, Laurent, Pellin, and others are dealt with.
J. W. P.

1399. *Photometry and Photometers.* **L. W. Phillips.** (British Optical Journ. 3. pp. 172–183, April, 1904. Paper read at a Students' Meeting of the Optical Society, Feb. 25, 1904.)—The author gives an illustrated description of the various forms of photometer, of the different standard lamps, and of the general equipment of the photometer-room. W. H. S.

1400. *Some Substances which Affect the Photographic Plate.* **E. van Aubel.** (Comptes Rendus, 138. pp. 961–963, April 18, 1904.)—A thin layer of colophane broken up into small pieces is put on a glass plate. Above this is a strip of copper-foil, and on the top a sensitive plate enclosed in black paper, and the whole is held in a light-tight box. After two days the colophane is found to have affected the plate where it was not shielded by the copper. Other substances have a similar effect, such as abietic acid, copal resin, and mastic resin. Melted colophane or Canada balsam is not so effective as the powdered material, and heat renders the substances inactive. An effect is also obtained from a solution of phenol in absolute alcohol. G. E. A.

1401. *Compensation of Interference and Measurement of Small Thicknesses.* **G. Meslin.** (Comptes Rendus, 138. pp. 957–959, April 18, 1904.)—A ray of light is passed through a thin plate, polarised, received on a plate of crystal (quartz cut parallel to the axis), and analysed. The retardation in the thin isotropic plate is compensated by that due to double refraction in the crystal, and the method is applied to the measurement of small thicknesses by using plates of quartz 1, 2, 5, &c., mm. thick for a kind of optical balancing analogous to the use of a box of weights. A Babinet compensator is also employed. Another method of compensation is mentioned in which the quartz is cut perpendicular to the axis. The advantage of the method lies in being able to compensate the effect of a thin plate by means of a quartz plate some hundreds of times thicker. [See also Abstract No. 527 (1904).] G. E. A.

1402. *Bi-rotation of Glucose.* **R. Behrend** and **P. Roth.** (Annalen d. Chemie, 331. pp. 359–382, 1904.)—The authors have investigated the acetyl derivatives of the two modifications of glucose, with a high and a low optical rotation respectively, and as a result agree with the conclusions of Armstrong. [See also Abstract No. 285 (1904).] L. H. W.

1403. *Method of Bringing Together the Two Spectra to be Compared in the Ordinary Spectrophotometer.* **J. R. Milne.** (Roy. Soc. Edinburgh, Proc. 24. pp. 496–500, 1902–1903.)—In order to overcome the difficulty to be met with in the spectrophotometer, of accurately bringing together the two spectra to be compared, the author adopts the simple device of inserting two half-lenses between the telescope object-glass and its focal plane. An ordinary achromatic lens is cut in half, and the two halves are mounted in the same vertical plane and are each provided with small adjustments round vertical and horizontal axes. By careful adjustment of the two half-lenses round the horizontal axes, the two spectra to be compared can be brought into absolute contact; the adjustment round the vertical axes is for the purpose of slightly displacing the two spectra relatively to one another in order to make spectrophotometric comparison by Murphy's method. E. C. C. B.

1404. *Shifts of Spark Lines.* **N. A. Kent.** (Astrophys. Journ. 17. pp. 286–299, May, 1903.)—The author describes an experimental investigation into the variations in wave-length of the spectrum lines of titanium, as produced by the two electrical conditions of the arc and spark, and concludes that the effects due to self-induction, impedance, &c., are sufficiently great to warrant this being considered in any work involving accurate determinations of fundamental wave-lengths. C. P. B.

1405. *New Spectroscope for Solar Prominences.* **A. Wolfer.** (Zeitschr. Instrumentenk. 23. pp. 165–168, June, 1903.)—A direct-vision spectroscope whose mounting is so arranged as to be especially convenient for work upon prominences. The slit possesses two movable jaws and can also be moved as a whole; it is possible to bring the sun's limb upon the slit, rotate the latter so as to be tangential or radial, and measure the height and position angle of any prominence, all by means of attachments to the spectroscope, without having recourse to the main telescope. E. C. C. B.

1406. *Simple Spectroscope for Thorp's Copies of Gratings.* **H. Lehmann.** (Zeitschr. Instrumentenk. 23. pp. 168–171, June, 1903. Communication from the optisch-astronomische Werkstätte von C. A. Steinheil Söhne.)—A simple fixed-arm direct-vision instrument with the grating mounted upon a rotating table whose angular deviations can be measured to 10″ upon a graduated quadrant. E. C. C. B.

1407. *Ultra-violet Spark Spectrum of Ruthenium.* **W. E. Adeney.** (Roy. Dublin Soc., Proc. 10. 3. pp. 24–47, Aug. 7, 1903.)—A long list of the wave-lengths of the lines in this spectrum, measured upon photographs taken with a 21·5 ft. Rowland grating; 1,461 lines have been measured between the limits $\lambda = 2263$ and $\lambda = 4560$. E. C. C. B.

1408. *Perot-Fabry Corrections to Rowland's Wave-length.* **L. Bell.** (Astrophys. Journ. 18. pp. 191–197, Oct., 1903.)—The paper contains a discussion of the possible difficulties in definitely deciding whether certain discrepancies in published wave-length tables may be systematic or accidental. [See Abstracts Nos. 1687 (1902), 46 (1903) and 1348 (1904).] C. P. B.

1409. *Revision of Rowland's Wave-lengths.* **J. Hartmann.** (Astrophys. Journ. 18. pp. 167–190, Oct., 1903.)—Some little confusion in the fundamental constants of wave-length determinations have arisen owing to the two systems of standard values published by Rowland, and now almost universally adopted by spectroscopic workers. One of these is the list of metallic arc lines, published in 1893, the other the values of the wave-lengths of the Fraunhofer lines in the solar spectrum, published in two different forms in 1893 and 1895–7. The author examines the discrepancies between the different values given by these three standards for certain lines distributed throughout the spectrum, and comparing them with determinations by later workers, deduces a series of correctional formulæ by the application of which any system may be expressed in terms of the others, tables of these corrections being given for certain selected regions. [See, however, Abstract No. 1348 (1904).] C. P. B.

1410. *Double Reversals.* **W. J. Humphreys.** (Astrophys. Journ. 18. pp. 204–209, Oct., 1903.)—The author draws attention to the many cases of apparent double reversal—that is the occurrence of a narrow bright line on the centre of the dark space of a broadly reversed one—and points out that in many instances the appearance is fictitious, being produced by the presence of overlapping orders in the spectra given with diffraction gratings. True instances of double reversal are readily seen in the spectra of the solar faculæ and spots, but it appears exceedingly difficult to produce it with only one source of light in the laboratory. By using two electric arcs in line with the slit of a spectroscope, and supplying the further one with considerably more material than the nearer one, he readily produced the phenomenon of double reversal, but under no conditions could the phenomenon be seen when using a single source of radiation. Photographs are reproduced illustrating both spurious and real double reversal. [See also Abstract No. 1414 (1904).] C. P. B.

1411. *Michelson's Theory of the Displacement of Spectral Lines.* **J. Fényi.** (Astrophys. Journ. 19. pp. 70–79, Jan., 1904. Also Memorie della Pontifica Accademia dei Nuovi Lincei, 21, 1903.)—The author deals with Michelson's theory that a displacement of lines must occur when a denser mass is introduced in the path of a ray of light. He gives another derivation of the formula, which is $\lambda_1 - \lambda_0 = \frac{c}{V - c}(n - 1)\lambda_1$, where λ_1 and λ_0 are the apparent and true wave-lengths of the ray, c is the velocity of the mass, and V that of light, and n is the index of refraction. The author tests the validity of this explanation, and concludes that while it accounts for very many of the displacement phenomena in solar spectroscopy, especially the peculiar displacements at high elevation of the prominences, yet certain cases favour the hitherto accepted explanation on Doppler's principle. E. C. C. B.

1412. *Energy Distribution in the Spark Spectra of Metals.* **A. Pflüger.** (Phys. Zeitschr. 5. pp. 34–36, Jan. 15, 1904. Physik. Institut der Univ., Bonn, Dec., 1903.)—The energy distribution in the spark spectra of various metals was investigated by means of a thermoelectric method [see Abstract No. 523 (1904)], between 186 $\mu\mu$ and 1,500 $\mu\mu$. All the metals examined, with the exception of magnesium, have a steep energy-maximum in the extreme ultra-violet just beyond 260 $\mu\mu$, the deflections for this part being ten times as great as for any other part of the spectrum. The triple magnesium line at 280 $\mu\mu$ is the strongest of all lines observed by the author. All the metals have another, much weaker, maximum in the infra-red between 700 $\mu\mu$ and 1,000 $\mu\mu$. G. E. A.

1413. *Harmonic Relations in the Spectra of Elements.* **C. Runge.** (Zeitschr. Elektrochem. 10. pp. 119–123, Feb. 19, 1904. Abstract of a Report read before the Chem. Gesell. zu Breslau, Jan. 22, 1904.)—A short account of our present knowledge of this subject. E. C. C. B.

1414. *Double Reversals.* **H. Konen** and **A. Hagenbach.** (Astrophys. Journ. 19. pp. 111–115, March, 1904.)—The authors mainly confirm the conclusions put forward by Humphreys [see Abstract No. 1410 (1904)], but think that in some cases it may be possible to obtain a true double reversal with a single arc. They instance a particular method of obtaining a strong consumption of magnesium, and state that in that case the line at λ2852·25 is immensely broadened and multiply reversed. From this experiment they conclude that genuine cases of double reversal do occur under special conditions. C. P. B.

1415. *Preliminary Measurement of the Short Wave-lengths Discovered by Schumann.* **T. Lyman.** (Nature, 69. p. 465, March 17, 1904.)—The author has succeeded in carrying measurements of wave-length to as far as $\lambda = 1206$, which is 648 Ångström units beyond the previous limit. He finds that speculum metal is able to reflect these rays to a very considerable degree, and is continuing the work. [See also Abstract No. 1323 (1904).] E. C. C. B.

1416. *Remarks upon Hertzsprung's Paper on the Comparison of some Spectrophotometric Results.* **O. Tumlirz.** (Phys. Zeitschr. 5. pp. 156–157, March 15, 1904.)—The author points out that Hertzsprung has omitted all reference to his paper upon the comparison of the intensities of the spectra of the sun and the Hefner lamp. These relative intensities were published in 1889 (Wien. Ber. 98. IIa., July, 1889), and if one compares them with the values obtained from the formula $\frac{1}{\epsilon} = C\lambda^5\left(\frac{1\cdot46}{e\lambda \times T} - 1\right)$, where ϵ is the intensity of the radiation and T is the absolute temperature, it will be found that there is no agreement. Hertzsprung also made use of Köttgen's determinations, but the author says that these are vitiated by the fact that the sun was cloudy. [See Abstract No. 1343 (1904).] E. C. C. B.

1417. *Spectra of Mixed Gases.* **P. G. Nutting.** (Astrophys. Journ. 19. pp. 105–110, March, 1904.)—The author reviews the available evidence with respect to the material action of gases in mixtures on their individual spectra. There appears to be a law which may be thus stated : "In the spectrum of a mixture of gases, other things being equal, the spectrum of the gas of greater atomic weight will be brighter." This is only demonstrable, however, in the case of gases under moderate electrical excitation, and when they are subjected to the action of strong arc or spark discharges the results appear so complex that the variations cannot be directly followed. Various practical tests are described in detail, the majority being made with the aid of Plücker tubes excited from a 2,000-volt alternating current. It was found that changes of current density over quite a wide range did not affect materially the spectral predominance induced by the proportion of a certain gas present in the mixture. A suggested explanation of the phenomenon, based on the electron theory, is given at length. C. P. B.

1418. *Corrections to Rowland's Wave-lengths.* **C. Fabry** and **A. Perot.** (Astrophys. Journ. 19. pp. 119–120, March, 1904.)—The authors discuss the suggestion by Bell that their absolute determinations of solar wave-lengths may be affected by radial velocity of the observer, and point out that they considered the possibility, but found the corrections negligible. [See also Abstract No. 542 (1904).] C. P. B.

1419. *Differences between the Spectra at Anode and Kathode in Certain Gases.* **G. D. Liveing.** (Cambridge Phil. Soc., Proc. 12. pp. 338–349, April, 1904.)—The appearance of the direct discharge, from an induction coil, in various gases has been observed, and the author considers that he has proved first that the two spectra of hydrogen are separated by the discharge just as in the case of nitrogen, one appearing at the kathode and the other in the capillary and at the anode ; and, second, that oxygen and sulphur give no anode light. Also he finds that there is only one spectrum in the case of metallic vapours and of carbonic oxide. Certain theoretical deductions are made from these and other observations, and finally a suggestion is put forward that the chromosphere and corona are to be considered as a huge kathode glow. E. C. C. B.

1420. *Radio-activity of Ordinary Materials.* **R. J. Strutt.** (Phil. Mag. 5. pp. 680–685, June, 1903.)—The rate of leak through air from a charged wire placed in the axis of a cylindrical vessel was observed when the walls of the vessel consisted of various materials. There were marked differences in the rate of leak when the surrounding material was changed, which indicates that the greater part, if not the whole, of the observed ionisation of air is not spontaneous but due to Becquerel rays from the containing vessel. Other experiments appear to show that the radiation from different samples of the same material varies, not only in quantity, but in quality also. J. J. S.

1421. N-*rays in Solar Radiation.* **R. Blondlot.** (Comptes Rendus, 136. pp. 1421–1422, June 15, 1903.)—Rays from the sun, which passed through the panels of oak shutters 1·5 cm. thick were found to show the presence of *n*-rays by their action in increasing phosphorescence. The phosphorescence diminished on the interposition of a lead screen. The *n*-rays from the sun also increase the brightness of a small electric spark or a small flame. J. J. S.

1422. *Emission of* N-*rays in certain Pathological Conditions.* **G. Ballet.** (Comptes Rendus, 138. pp. 524–526, Feb. 22, 1904.)—There is a diminution in the emission of *n*-rays at the level of the paralysed or atrophied muscles in cases of myopathy, neuritis, or poliomyelitis, that is in the regions of the lower motor neuron. But there is an increase in cases where the lesion is situated in the upper neuron. In hysterical paralysis the emission of *n*-rays is increased at the level of the affected muscles. H. W. P. Y.

1423. *Secondary Radiation Induced by Röntgen Rays.* **A. W. Goodspeed.** (Scientific American, 88. p. 425, June 6, 1903. From the Pennsylvanian.)—Notes on observations of secondary activity produced by X-rays. J. J. S.

1424. *Action of Radium on Colloids, Hæmoglobins, Ferments, and Red Blood Cells.* **V. Henri** and **A. Mayer.** (Comptes Rendus, 138. pp. 521–524, Feb. 22, 1904.)—The β radiations cause precipitation of positive colloids in the presence of a small quantity of an electrolyte, but have no action on negative colloids. Oxyhæmoglobin obtained from a dog or frog is transformed into methhæmoglobin, and is subsequently slowly precipitated. Invertin, emulsin, and trypsin submitted to the action of radium progressively lose their activity, and after several days' exposure become completely inert. Red blood cells become less resistant, and give up their hæmoglobin and salts to solutions of salt and sugar more readily than normal cells. H. W. P. Y.

1425. *Blondlot* N-*rays.* **A. A. Campbell Swinton.** (Nature, 69. p. 412, March 3, 1904.)—An account of further endeavours to confirm Blondlot's experiments. The results obtained, however, were found to be due in every case simply to heat. [See also Abstract No. 802 (1904).] J. J. S.

1426. *Phototherapy, and its Application in Cases of Lupus.* **Finsen.** (Comptes Rendus, 136. pp. 1596–1598, June 22, 1903.)—Statistics of the cases treated at the Finsen Institute, Copenhagen, from Nov., 1895, to Jan. 1, 1902. As regards the technique of the treatment, great importance is attached to this. The use of a 60–80-amp. lamp will increase the rapidity of the effects threefold as compared with a 40-amp. lamp. L. H. W.

1427. *Deep Phototherapy by Sensitising the Tissues.* **S. Leduc.** (Archives d'Él. Médicale, 12. pp. 203–205, March 25, 1904.)—A discussion of the work by Dreyer on the sensitising action of certain fluorescent substances on bacteria and infusoria to the orange and yellow rays of the spectrum and the possibility of sensitising the tissues by similar methods in phototherapy. H. W. P. Y.

1428. *New Rays or a New Emanation.* **J. J. Taudin Chabot.** (Phys. Zeitschr. 5. pp. 103–104, Feb. 15, 1904.)—An account of experiments with preparations of selenium, in which photographic effects were obtained on sensitive plates, which are to be further investigated. J. J. S.

1429. *Radio-activity of Hot Springs and Gas Wells.* **R. Nasini.** (Accad. Lincei, Atti, 13. pp. 217–218, March 6, 1904.)—Preliminary note on an investigation now being carried out as to radium, helium, radio-activity of the water, the gases, and the solids deposited at the different springs in Italy, and as to some volcanic rocks. Some baryta spar from Vesuvius has been found very radio-active. A. D.

1430. *Polarisation in Röntgen Rays.* **C. G. Barkla.** (Nature, 69. p. 463, March 17, 1904. University of Liverpool, March 10.)—An account of experiments which show that the radiation proceeding from a bulb is partially polarised. J. J. S.

1431. *Blondlot's* N-*rays.* **R. Blondlot.** (Electrician, 52. p. 830, March 11, 1904.)—A translation of a letter from Blondlot, in which he names various scientific men who have been convinced, by witnessing his experiments, of the existence and properties of *n*-rays. He is satisfied that the phenomena have been proved not to be due to heat. J. J. S.

1432. *Radio-tellurium.* **W. Marckwald.** (Nature, 69. p. 461, March 17, 1904.) **F. Soddy.** (Nature, 69. pp. 461–462, March 17, 1904.)—An account of experiments with the substance provisionally called radio-tellurium by Marckwald, which he considers to be different from polonium. In the second letter Soddy discusses Marckwald's experiments with the preparation, and concludes that it is identical with polonium, previously discovered by Madame Curie. J. J. S.

1433. N-*rays.* **W. A. D. Rudge.** (Nature, 69. pp. 437–438, March 10, 1904.)—A barium platinocyanide screen was rendered faintly luminous in the dark when a small quantity of radium was sprinkled upon it. On placing the screen close to the eye, and touching the back of it under the luminous patch with the finger, an alteration in the intensity of the light was observed. Pressure with the finger seemed to decrease the luminosity. A piece of metal produced the same effect as the finger. J. J. S.

1434. *Blondlot's* N-*rays.* **C. C. Schenck.** (Nature, 69. pp. 486–487, March 24, 1904.)—An account of an attempt to repeat Blondlot's experiments, which gave no successful result. The author criticises Blondlot's account of his method of obtaining the index of refraction and wave-length of *n*-rays, and considers that under the conditions of the experiment it would hardly be possible to detect the existence of separate beams. In the diffraction experiment, calculating from Blondlot's numbers, he thinks there would be no definition, and the broad central band, together with the broad diffracted bands, would hardly separate out at all. J. J. S.

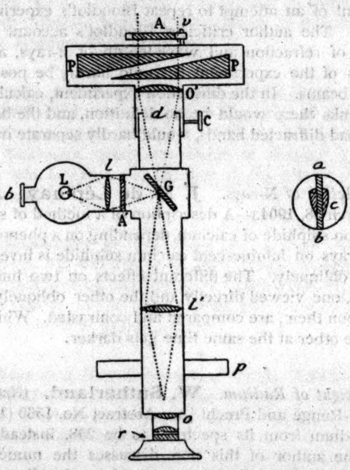
1435. *Objective Action of* N-*rays.* **J. M. de Lépinay.** (Comptes Rendus, 138. pp. 798–799, March 28, 1904.)—A description of a method of showing the objective action of *n*-rays on sulphide of calcium, depending on a phenomenon of contrast. The action of the *n*-rays on luminescent calcium sulphide is inverted when the surface is viewed very obliquely. The different effects on two luminescent surfaces placed close together, one viewed directly and the other obliquely whilst the *n*-rays simultaneously act upon them, are compared and contrasted. Whilst the one surface becomes brighter, the other at the same time gets darker. J. J. S.

1436. *Atomic Weight of Radium.* **W. Sutherland.** (Nature, 69. pp. 606–607, April 28, 1904.)—Runge and Precht [see Abstract No. 1360 (1903)] work out the atomic weight of radium from its spectrum to be 258, instead of 225 found by Madame Curie. The author of this note discusses the numerical relationships shown in spectra, and points out that the spectra data of radium support the value of the atomic weight given by Madame Curie, if handled according to the method previously described by him. [See Abstract No. 37 (1902).] J. J. S.

1437. *Radio-activity and the Law of Conservation of Mass.* **O. W. Richardson.** (Nature, 69. p. 606, April 28, 1904.)—In the case of two methods of deducing the average life of a radium atom recently mentioned by Soddy, the results become concordant if it is assumed that the complete disintegration of an atom of radium involves the emission of four α particles. Now the atomic mass of radium is 225, and that of an α particle about 2; the question therefore arises as to what has become of the rest of the mass. There appear to be three possible answers: (1) The estimate may be wrong by a factor of ten, though this is unlikely; (2) the various stages of the disintegration may involve the liberation of by-products non-radio-active, and thus not to be detected by the methods employed; (3) there may be a decrease in the total mass of the system owing to the decrease in the velocities of some of the constituent electrons. J. J. S.

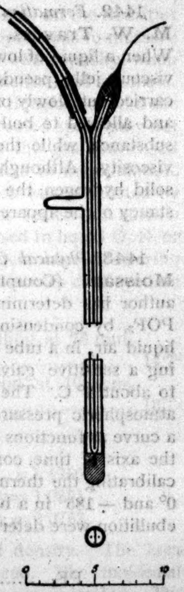
HEAT.

1438. *Absorption Pyrometer.* **C. Féry.** (Journ. de Physique, 3. pp. 32–37, Jan., 1904.)—The principle of the pyrometer depends on the fact that the variation of intensity of an elementary radiation with temperature and the law of absorption are both expressible in similar exponential forms. A section of the instrument is shown in the Fig. The rays from the furnace or other hot body pass through the glass plate A, the glass wedges P, P′, are focussed at G, a glass plate silvered along a central strip, and are received in the eyepiece O, in which they are compared photometrically with the rays from a standard lamp L, reflected from the silvered strip at G. The field of view is shown at the side, *ab* being the silvered strip and *c* the image of a crucible. The displacements of the wedges P, P′, caused by a pinion and read on a scale not shown, give a straight line when plotted with the reciprocals of the absolute temperature of the hot body. By removing the absorbing plates A or A′, which are identical, straight lines parallel to and equidistant from the first are obtained. A range of 1,100° to 3,800° can be had by using the pinion alone, without changing the glasses, and a trial with a standardised electric furnace showed, between 1,000° and 1,500°, maximum errors of less than 10°, represented on the scale by about 1 mm. The plate *p* acts as screen and counterpoise, and *r* is a piece of red glass. The temperature of the electric arc was measured by the instrument [see Abstract No. 2075 (1902)]. No details of the lamp L are given. [See also Abstract No. 319 (1904).] G. E. A.



1439. *External Heat Conductivity of Silver Wires immersed in Water.* **E. Rogovsky.** (Comptes Rendus, 136. pp. 1391–1393, June 8, 1903.)—By external conductivity is meant the quantity of heat passing across 1 sq. cm. of surface per sec. for 1° C. difference of temperature between the body and the surrounding medium. The experiments have been carried out on silver wires of 0·281 mm. to 0·868 mm. diam. stretched and enclosed in tubes of glass of 1 cm. internal diam., through which currents of distilled water pass continuously, having velocities of from 87 to 104 cm. per sec. The methods employed in the determinations were analogous to those of Rivière, and Ayrton and Kilgour in their researches on the emissive power of wires in air and in gases. The author finds that the external conductivity $H = \left\{(c + mt_0)/d^n + (e + pt_0)d^{n_1}\theta\right\}\sqrt{v}$, where t_0 is the temperature of the surrounding water, θ the difference in temperature of the wire and the water, v the velocity of the water, and c, m, e and p constants, the exponent n being negative and having a value equal to 3 for pure silver wires of from 0·415 to 0·281 mm. diam., and diminishing for wires having a greater or less diam. The exponent n_1 varies from $-0·182$ for wires of pure silver from 0·415 to 0·281 mm. diam. to $+0·702$ for wires of impure silver from 0·326 to 0·194 mm. in diam. E. C. R.

1440. *Measurement of very Low Temperatures.* **H. Kamerlingh Onnes** and **C. A. Crommelin.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 642–648, March 23, 1904. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, Feb. 27, 1904.)—This is the sixth communication on the subject and deals with improvements of protected thermo-elements and with the construction of a battery of standard thermo-elements, and its use for the determination of temperature. The experiments of Hollmann have already offered an opportunity for remarks about some of the new arrangements. [See Abstract No. 577 (1904).] For the observation element constantan and steel are used, and they found that a junction gave 46 microvolts per degree between 0°–100° C. The junction is enclosed in a glass protecting tube and soldered to a copper block at the end of the tube. Formerly it was very difficult to make a connection between the copper and the protecting tube. They now adopt the method of Cailletet, and solder the copper on to the glass. To effect this the glass tube is platinised at the end with $PtCl_4$ in the blowpipe, then it is coppered by electro-deposition, and next tinned over an alcohol flame. A thin rim is now placed in position on the tube and soldered to the block. Finally the cap, the seam, and the tinned glass are plated with platinum and then with gold by a battery. In this way a fit that is perfectly tight and permanent is obtained. For the filling of the tubes dry hydrogen is recommended. The diagram shows one type of the protected element. They have succeeded in obtaining elements which give a constant e.m.f. and could be used for standards. Favourable experiments made with a German-silver and copper element lead them to replace a single thermo-element by a battery of three standard thermo-elements, each with its own boiling apparatus and ice vessel. Two of the elements were made of constantan.



steel, and the other of German-silver and copper, which has a thermo-electric constant one-third of the other combination. By the use of a convenient switch it is possible to arrange single elements or combinations of them in series or in opposition and obtain e.m.f.'s in the ratios of 1, 2, 3, 4, 5, 6, and 7. This switch is made of electrolytic copper packed in a case and surrounded with cotton-wool. The galvanometer used was that of Einthoven [see Abstract No. 1190 (1904)]. Finally, a convenient potentiometer arrangement is described. W. W. H. G.

1441. *Heat of Vaporisation of Oxygen and Sulphur Dioxide.* **T. Estreicher.** (Acad. Sci. Cracovie, Bull. 3. pp. 183–196, March, 1904.)—The heat of vaporisation was determined by passing an electric current through a resistance immersed in the liquefied gas contained in a vacuum vessel. This vessel was placed in a freezing mixture for sulphur dioxide, and in liquid air for oxygen. The current was measured by a silver coulombmeter, and the p.d. across the resistance by a sensitive voltmeter. After allowing the current to flow for a definite time, the volume of gas evolved was measured. From these data the heat of vaporisation was calculated. The mean of several experiments gave for liquid sulphur dioxide 96·2 cals. per gm., and for liquid oxygen 58·0 cals. per gm. Drawings of the apparatus used are given. F. S.

1442. *Formation of Solids at Low Temperatures, especially Solid Hydrogen.* **M. W. Travers.** (Roy. Soc., Proc. 73. pp. 181–183, March 23, 1904.)—When a liquid of low freezing-point is cooled, a crystalline substance or a very viscous jelly (pseudo-solid) is obtained, according to whether the cooling is carried out slowly or rapidly. Liquid hydrogen, when kept constantly stirred and allowed to boil in a vacuum and so solidify, yields a flocculent, glassy substance, while the non-solidified portion exhibits no great increase in its viscosity. Although there is no direct evidence of the crystalline nature of solid hydrogen, the sharpness with which the solid is formed, and the constancy of the apparent melting pressure, point to this conclusion. T. H. P.

1443. *Physical Constants of Phosphorus Fluorides and Oxyfluoride.* **H. Moissan.** (Comptes Rendus, 138. pp. 789–792, March 28, 1904.)—The author has determined the melting- and boiling-points of PF_3, PF_5, and POF_3, by condensing and freezing the dry and purified gas by means of liquid air, in a tube containing a thermo-electric junction, the circuit including a sensitive galvanometer capable of reading 0·5 millivolt, equivalent to about 2° C. The temperature of the gas was then allowed to rise under atmospheric pressure, and the indications of the galvanometer plotted on a curve as functions of the time. At two points the curve becomes parallel to the axis of time, corresponding to the melting- and boiling-points, and by calibrating the thermo-electric couple with a standard thermometer, between 0° and − 185° in a bath of petroleum ether, the temperatures of fusion and ebullition were determined, with the following results :—

	Melting-point.	Boiling-point.
PF_3	− 160°	− 95°
PF_5	− 83°	− 75°
POF_3	− 68°	− 40°

The drying and purification of the gases for these determinations was effected by means of an apparatus previously described [see Abstract

No. 1462 (1904)], consisting of a series of specially shaped glass tubes immersed in Dewar vacuum flasks containing freezing liquids which freeze out any moisture, followed by a small glass condenser in which the gas collects, and whence it is fractionally distilled off from any impurities.

W. H. SI.

1444. *Convection of Heat.* **H. A. Wilson.** (Cambridge Phil. Soc., Proc. 12. pp. 406–423, April, 1904.)—The general differential equation of this distribution of temperature in a moving medium is established, viz. :—

$$\partial(\rho\theta)/\partial t = (k/s)(\partial^2/\partial x^2 + \partial^2/\partial y^2 + \partial^2/\partial z^2)\theta - \left\{\partial(\rho\theta u)/\partial x + \partial(\rho\theta v)/\partial y + \partial(\rho\theta w)/\partial z\right\}$$

where θ, ρ, u, v, w are the temperature, density, and velocity components at the point (x, y, z) at the time t, and s, k are the specific heat and conductivity supposed constant. By help of the equation of continuity this reduces to

$$\partial\theta/\partial t = (k/\rho s)(\partial^2/\partial x^2 + \partial^2/\partial y^2 + \partial^2/\partial z^2)\theta - (u\partial/\partial x + v\partial/\partial y + w\partial/\partial z)\theta.$$

The equation is then employed to determine the distribution of temperature in particular cases when a medium flows steadily between fixed boundaries with given boundary conditions. R. E. B.

1445. *Physical Constants at Low Temperatures.* **J. Dewar.** (Roy. Soc., Proc. 73. pp. 251–261, April 9, 1904.)—Describes experiments on the densities of solid oxygen, nitrogen, and hydrogen. The method adopted was to measure the volumes of the gases sucked into a cooled space of known capacity, when the temperature was lowered sufficiently to induce liquefaction and solidification. A successful experiment demands that the rate of liquefaction and the cooling must be under thorough control, otherwise the cooled space may not get completely filled with solid. Further, the volume of the gas condensed must be at least 20 litres in order to diminish errors due to manipulation. The dry purified gas was contained in a gas-holder, which was connected by a pipe with a glass bulb of 20 or 30 c.cm. This bulb was sealed to a narrow glass tube having a stopcock at the end. It was immersed in liquid O, N, or H contained in a vacuum-jacketed vessel having arrangements for lowering the temperature of the liquids by exhaustion. The temperatures employed on the absolute scale were—

Boiling-point of O	90·5°	Hydrogen boiling at 76 mm. pressure	14·7°
Boiling-point of N	77·5°	Hydrogen solid at 10 mm. pressure	13·1°
Melting-point of N	62·5°		
Boiling-point of H	20·5°		

The following values were obtained—

Solid Oxygen at boiling-point of H, density = 1·4256
Solid Nitrogen at boiling-point of N, density = 1·0265
Solid Hydrogen at H under 10 mm., density = 0·0763

Formulæ are established connecting temperature and density. The laws obtained enable other thermal constants to be deduced. The molecular volumes of the condensed gases at absolute zero are approximated. The results are compared with the values deduced from theoretical investigations and the formulæ proposed by Waterston-Avenarius, Baly and Donnan, Guldberg, van der Waals, Rankine, and others. A number of discrepancies are pointed out, which can only be cleared up by further research. W. W. H. G.

1446. *Electric Resistance Thermometry at Low Temperatures.* **J. Dewar.** (Roy. Soc., Proc. 73. pp. 244–251, April 9, 1904. Bakerian Lecture.)—It has previously been shown [see Abstract No. 1288 (1901)] that the constant-volume hydrogen thermometer is reliable under varying conditions, down to a temperature some degrees below the boiling-point of hydrogen. On the other hand, the thermo-electric and electric resistance methods were not satisfactory. In the present communication the experimental records of eight additional electric resistance thermometers are given. Further, the results of the observations on all the resistance thermometers used during the investigations are collected and compared. Two facts are deduced from the inquiry: (1) That the resistance of an unalloyed metal continually diminishes with temperature and appears to approach a definite asymptotic value below which no further lowering of the temperature seems to reduce it; and (2) that the parabolic connection between temperature and resistance is no longer tenable at very low temperatures. The metals employed were Pt, Au, Ag, Ca, Pd, Fe, Ni, and two alloys, platinum-rhodium and German-silver. Every endeavour was made to attain the highest purity in the samples. The observed resistances after all corrections were made were reduced by Callendar's and Dickson's methods. Various peculiarities of the different materials are noted. It is remarkable that in the cases of the purest metals their resistances, calculated by either method of reduction, vanish at temperatures above —273° C. As measurers of temperature, gold and silver seem to be the best. A plate is given showing the result of plotting the relations between resistance and temperature between —252·5° C. and + 100° C. It is clear from these results that in no case can anything parabolic connect resistances and temperatures ranging from the boiling-point of water to that of hydrogen.

W. W. H. G.

1447. *Depression of Freezing-point in Concentrated Aqueous Solutions of Non-electrolytes.* **W. A. Roth.** (Zeitschr. Phys. Chem. 43. pp. 539–564, May 12, 1903. II. Chem. Inst., Berlin.)—The author considers the various causes which conduce to non-agreement with van't Hoff's rule, and reviews former work on gas dissolved in glycerol and sucrose. He investigates glucose, chloral hydrate, acetic acid, glycocol, and thio-urea in an apparatus modified from those of Abegg and Hausrath. None of these substances act normally, the first two giving too large, the others too small depressions. The probable error runs to about 0·2 per cent., but the results cannot be effectively condensed.

H. H. F. H.

1448. *Melting-point Curves of Mixtures of Silver Sulphide and Antimony Sulphide.* **H. Pélabon.** (Comptes Rendus, 136. pp. 1450–1452, June 15, 1903.)—Gradually increasing quantities of sulphide of silver were added to sulphide of antimony, and the effect on the temperature of solidification noted. The mixture was melted in a glass tube, and the temperature observed by a small thermo-electric couple. If the melted mixture is allowed to cool it is easy to obtain a curve showing the relation between time and temperature. From this curve the temperature of commencing solidification can be found. If the relation between the percentage of silver sulphide in the mixture and the corresponding temperature of commencing solidification is plotted, the fusibility curve of the mixture is obtained. The two maxima in this curve indicate the existence of two definite compounds, Sb_2S_3, Ag_2S and Sb_2S_3, $3Ag_2S$. There are three minima corresponding to three different eutectic mixtures.

F. S.

1449. *Freezing-point Curves for Binary Mixtures of Organic Substances, chiefly Phenols and Amines.* **J. C. Philip.** (Chem. Soc., Journ. 83. and 84. pp. 814–834, July, 1903.)—The initial freezing-points of a series of mixtures of two substances, graphically represented in relation to the concentration, form a curve which, in the simplest case, consists of two branches starting from the freezing-points of the components and meeting in a eutectic point. If, however, the two substances are able to form a compound, these two branches are cut by another, intermediate curve, which in some cases exhibits a maximum. Examples of this last type of curve are found in the system phenol-urea, in which the maximum corresponds with a mixture containing 33 mols. per cent. of urea and also in the systems *p*-cresol-aniline, phenol-*a*-naphthylamine, phenol-*p*-toluidine, *a*-naphthol-*p*-toluidine, and phenol-picric acid, where the maximum occurs when the components are in molecular proportion. According to Roozeboom's theory, the intermediate curve reaches its maximum when the mixture has the same composition as the compound formed, and this compound crystallises out from all mixtures lying within the limits of the intermediate portion of the curve. In the above-mentioned cases this view was confirmed by analyses of the crystals separated. In the phenol-urea curve the intermediate portion is suddenly cut at its maximum by another branch which apparently ends at the freezing-point of urea. With the phenol-*p*-toluidine mixtures, the compound formed exists in two modifications, each giving an intermediate part of the curve. The compound of phenol with *a*-naphthylamine crystallises so slowly that it is possible to realise the ordinary branches of the freezing-point curve below the intermediate part and below the eutectic temperature. T. H. P.

1450. *Kinetic Theory of Monatomic Bodies.* **G. Mie.** (Ann. d. Physik, 11. 4. pp. 657–697, June 22, 1903.)—This paper is of too mathematical a character for adequate abstract; but the author deduces results, among which are the following: (1) Liouville's theorem is not rigidly applicable in this theory; (2) the saturation-pressure of a vapour at temperature T is proportional to $(RT)^{-\frac{1}{2}}e^{-Q/RT}$, where R is the gaseous constant and Q the real latent heat; (3) the product of the molecular volume, modulus of compression and coefficient of thermal expansion is for all amorphous monatomic bodies the same multiple of R; (4) the temperature-coefficient of the potential-difference between a metal and an electrolyte is negative and varies inversely as the valency of the metal. R. E. B.

1451. *Electrical Conductivity of Methyl-alcoholic Solutions near their Critical Point.* **C. A. Kraus.** (Phys. Rev. 18. pp. 40–56, Jan., and pp. 89–103, Feb., 1904. Physical and Chemical Labs., University of California, Berkeley, Sept., 1903.)—The results of the author's investigations on the conductivity of solutions of potassium iodide in methyl alcohol in the neighbourhood of their critical points are briefly as follows: (1) Solutions in methyl or ethyl alcohol possess maxima of electrical conductivity, the former at about 150° and the latter near 100°. (2) Solutions in these alcohols conduct beyond the critical point, those in methyl alcohol the better. (3) The temperature coefficient of a solution in methyl alcohol undergoes a sudden change at the critical point. This phenomenon is apparent only when the tube is completely filled with liquid at the critical point or when the solvent passes through the critical point without stirring. (4) An unsaturated vapour solution exhibits no discontinuity at the critical point of the solvent. Solutions consisting of mixtures of gasogenic and liquidogenic molecules exhibit a great change of the conductivity immediately beyond the critical point, but a discontinuity of the tangent cannot be established. (5) Methyl alcohol presents the same phenomena of non-homogeneity beyond the critical point as do other liquids studied in this connection. (6) When large quantities of solvent are present, the conductivity is nearly proportional to the quantity of solvent. With smaller quantities of solvent, the ratio of increase of conductivity is much smaller. As the critical point is approached, the ratio of increase of conductivity with increase of solvent is increased. (7) The vapour of a solvent may become a very good conductor in the neighbourhood of the critical point. The conductivity increases very largely for a saturated vapour as the critical point is approached, owing to increasing density of both solvent and solute. T. H. P.

1452. *A Case of Correspondence in Thermodynamics.* **A. Giammarco.** (N. Cimento, 5. pp. 377–391, June, 1903.)—The law of corresponding states in thermodynamics originates in van der Waals' formula $\left(\pi + \frac{3}{w^2}\right)(3w - 1) = \delta\tau$, in which π, ω, and τ denote respectively pressure, volume, and temperature. The writer mentions difficulties which have occurred in the experimental verification of this law, with especial reference to Zambiasi's paper (Rendiconti dell' Accad. Lincei, serie V., 1895). Zambiasi raises two questions: (1) For a given quantity of liquid, what volume should be used if we wish to measure the critical elements? (2) The volume being chosen, what test should we apply for the various phenomena to be observed? The writer answers the first question as follows: He considers two densities d, d', and the ratio, V/V′, of the volume of the liquid to that of its vapour in a Natterer tube. Taking two rectangular axes of co-ordinates, the temperature being the abscissa, and V/V′ the ordinate, it is found that the diagram consists of two regions, in one of which V/V′ attains maximum values, in the other it does not. It is found, further, that all the maxima lie in a straight line. In this the writer finds a new verification of the law of corresponding states, and great practical advantages in measurement. Diagrams are given showing the relation between temperature and V/V′ for the three substances ether, alcohol, and chloroform, and numerical tables are also given for the same relations. The writer finds that not only are the maxima of V/V′ always in a right line, but that if T_c, T_c' denote the critical temperatures for two substances, and if T, T′ be two other temperatures such that $\frac{T}{T_c} = \frac{T'}{T_c'}$, the values of V/V′ corresponding to T, T′ are equal. This is illustrated by a numerical table. The writer agrees with Zambiasi (in the above note) that the phenomena of disappearance and reappearance of the meniscus are reversible only for a certain initial value of V/V′, which has its maximum at the temperature of disappearance, this being for ether 0·508 according to the writer, or 0·50 or 0·51 according to Zambiasi. By this method the true critical temperature of a substance and the critical volume are easily calculated and, the writer says, a great step is made towards a general proof of the theorem of corresponding states. S. H. B.

1453. *Critical Heat of Evaporation.* **G. Teichner.** (Ann. d. Physik, 13. 3. pp. 611–619, Feb., 1904. Extract from the Wiener Inaugural Dissertation. Phys. chem. Labor. d. techn. Hochschule, Charlottenburg.)—Calorimetric measurements of the total heat required to raise a quantity of ether contained in a closed tube from 17° up to various temperatures (158°–220°) lying below and above the critical point. On plotting the "mean specific total heat," so obtained, against temperature-range, there are obtained two straight lines intersecting about 194° C. The measurements were made at the instigation of J. Traube in the hope of obtaining some experimental basis for the theory of "gasonen" and "fluidonen." Unfortunately, however, the measurements support the "theory" (?) of Andrews. F. G. D.

1454. *Boiling-points of Homologous Compounds.* **H. Ramage.** (Cambridge Phil. Soc., Proc. 12. pp. 445–448, April, 1904.)—On comparing the boiling-point curve of the paraffin hydrocarbons with that given by Walker's formula, $T = aM^{b}$ (where T is the boiling-point and M the molecular weight of the hydrocarbon, and a and b are constants), it appears probable that this formula applies only to the CH_2 chain linkage, and that the influence of the terminal hydrogen atoms in the higher members of the series is either a constant or is so small that it may be disregarded; the influence of these terminal atoms increases as the chain shortens. The author, therefore, suggests a new formula, $T = a\,[M(1 - 2^{-n})]^{b}$, where n is the number of carbon atoms in the molecule, and a the same constant as Walker used; a may, however, be expressed in terms of the pressure P, and, from 15 to 760 mm. pressure, $a = 23{\cdot}5\,P^{0{\cdot}07}$. For 760 mm. the value of a is 37·3775. The following table shows the observed and calculated boiling-points for the paraffins up to hexadecane :—

Paraffin.	Boiling-points.		Differences.
	Observed.	Calculated.	
CH_4	108·3°	105·7°	−2·6°
C_2H_6	180·0	177·3	−2·7
C_3H_8	228·0	231·9	+3·9
C_4H_{10}	274·0	275·6	+1·6
C_5H_{12}	309·3	312·2	+2·9
C_6H_{14}	342·0	343·9	+1·9
C_7H_{16}	371·4	372·3	+0·9
C_8H_{18}	398·5	398·3	−0·5
C_9H_{20}	422·5	422·5	0
$C_{10}H_{22}$	446·0	445·2	−0·8
$C_{11}H_{24}$	467·5	466·8	−0·7
$C_{12}H_{26}$	487·5	487·3	−0·2
$C_{13}H_{28}$	507·0	507·0	0
$C_{14}H_{30}$	525·5	526·0	+0·5
$C_{15}H_{32}$	543·5	544·2	+0·7
$C_{16}H_{34}$	560·5	561·9	+1·4

For the normal alcohols, the equation, $T = 286{\cdot}2 + 1{\cdot}41\,M$ gives the boiling-points; for the aldehydes, $T = 209{\cdot}14 + 1{\cdot}9286\,M$, and for the ketones, $T = 250{\cdot}07 + 1{\cdot}4643\,M$. It is noteworthy that the difference in boiling-points of two ketones differing in composition by CH_2 is about 41·0°, which is also the difference between the first constants in the above expressions giving the boiling-points of the aldehydes and ketones respectively. T. H. P.

1455. *Melting-point Lines of the System Sulphur + Chlorine.* **H. W. Bakhuis Roozeboom** and **A. H. W. Aten.** (Konink. Akad, Wetensch, Amsterdam, Versl. 12. pp. 599–605, March 28, 1904. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, Feb. 27, 1904.)—The authors discuss, with the help of two diagrams, the equilibria in the systems sulphur and chlorine at the temperatures of the freezing-points. The possible solid phases are Cl_2, SCl_4, S_2Cl_2, and S. The manner in which these may be deposited are fully discussed. Solutions of the gross composition SCl_4 begin to deposit solid SCl_4 at —30°, but no complete solidification takes place below —80°. The true melting-point of SCl_4 without decomposition of the liquid is not known. The curves for Cl_2 and S_2Cl_2 without formation of a compound have been realised. The authors conclude also from their experiments that in the liquid there is formed a quantity of SCl_2. [See also Abstract No. 323 (1904).] A. F.

1456. *Dissociation Curves.* **A. Bouzat.** (Comptes Rendus, 136. pp. 1395–1397, June 8, 1903.)—Calculations founded on the experimental data of about 35 systems have established the truth of the following statement: For all univariant systems in which a solid dissociates into another solid and a gas, the ratio of the temperature of any two systems corresponding to the same pressure is a constant independent of the pressure. From this it can be proved thermodynamically that Q_T/T has the same value for all values of the pressure, when Q denotes the heat absorbed by the dissociation of one gaseous molecule at the temperature T. Hence results the following statement: For all univariant systems satisfying the above condition, the variation of entropy corresponding to the dissociation of one gaseous mol. at a definite pressure is the same for all the systems. F. G. D.

1457. *Duhem's "Law of Regnault."* **J. v. Zawidzki.** (Zeitschr. Phys. Chem. 46. pp. 21–29, 1903. From the Chemisches Laboratorium des Polytechnikums, Riga.)—Starting from an observation of Regnault's that the three-phase pressure of the system ether-water at various temperatures is equal to that of pure ether, Duhem developed (*cf.* Mecanique chimique, 4. 204, 1889) the following "law of Regnault": If the three-phase pressure of a binary liquid mixture is equal to that of the more volatile pure constituent, then this is also true for the two-phase pressures of those mixtures which contain a preponderating proportion of the volatile constituent. The composition of the vapour in the last-mentioned two-phase region must be identical with that of the liquid. Regnault's observation was confirmed by measurements made by Marchis (C. R. 116. 388, 1893) at Duhem's instigation. Zawidzki now shows by careful boiling-point measurements in a Beckmann apparatus that the observations of Regnault and Marchis are erroneous. This is in agreement with previous measurements made by Linebarger (Chem. News, 70. 52, 1894), and by Beckmann (*cf.* Nernst, Zeit. phys. Chem. 8. 134, 1891). The author also proves experimentally by isothermal distillation and (optical) analysis of the liquid and vapour phases that the result obtained by C. Holley (Journ. Amer. Chem. Soc. 24. 448, 1902), namely, that the boiling-point of propyl alcohol is not altered by an addition of as much as 30 per cent. of amyl iodide, is also erroneous. Duhem's so-called law must therefore be erased from scientific literature. F. G. D.

1458. *Van der Waals' Equation of State.* **P. Kohnstamm.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 954–961, May 27, 1904.)—The author considers the various theoretical equations, and shows that the strict form is $\left(p + \frac{a}{v^2}\right) = \frac{RT}{v}\left(\lambda + \frac{b}{v}\beta\right)$, where $\beta = \phi\left(\frac{b}{v}\right)$, and is connected with the number of impacts (see next Abstract). By a consideration of the surfaces of impact and of influence he arrives at a form analogous to that of van der Waals, Jr. [See Abstract No. 905 (1903).] H. H. F. H.

1459. *Mean Free Path after Clausius and van der Waals.* **P. Kohnstamm.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 961–967, May, 27, 1904.)—This paper considers the spheres of action, &c., as treated by various physicists, and cannot be satisfactorily abstracted. H. H. F. H.

REFERENCES.

1460. *Thermal Conductivity of Argon and Helium.* **W. Schwarze.** (Ann. d. Physik, 11. 2. pp. 303–330, May, 1903. The part on Argon is from the author's Dissertation. Halle, Physik. Inst., Feb. 14, 1903.)—This is the full paper corresponding to that of Abstract No. 1198 (1903), giving a full description and theory of the experimental method employed and the results obtained. The value of *f* for helium given before, viz., 2·490, here appears as 2·507. R. E. B.

1461. *Determination of Molecular Weights.* **E. Beckmann.** (Zeitschr. Phys. Chem. 44. pp. 161–196, June 23, 1903. Laboratorium f. angew. Chemie d. Universität, Leipzig.)—The author describes still further improvements [compare Abstract No. 1908 (1902)] in his boiling-point apparatus, the tube by which the vapour of the solvent is introduced into the solution being fused into the boiling-point tube near the bottom instead of at the top; in this way the greater portion of this tube is within the outside boiling vessel. Modifications are also suggested for the freezing-point apparatus with electromagnetic stirrer. An apparatus for using liquid air as cooling agent is also described, the liquid air being introduced between an inner and an outer Dewar vacuum tube. Criticisms on the freezing-point apparatus are replied to. T. H. P.

1462. *New Apparatus for Preparation of Pure Gases.* **H. Moissan.** (Comptes Rendus, 137. pp. 363–369, Aug. 10, 1903.)—A simple apparatus which enables most gases to be produced in a state of great purity is described. It consists of a series of tubes of small volume immersed in Dewar vacuum-jacketed flasks containing freezing liquids to desiccate the gases and a condenser to collect them. The purification is effected by liquefying the gas in a tube, solidifying it, and then producing a vacuum in the tube. The solid is then allowed to return to the liquid and eventually the gaseous state at the ordinary temperature, impurities, if any, being then removed by fractional distillation. The arrangements are fully described, and the preparation of carbon dioxide, hydriodic acid, hydrochloric acid, phosphoretted hydrogen, sulphuretted hydrogen, and nitric oxide by this method is indicated. L. H. W.

1463. *Thermochemistry of Lead Compounds.* **A. Colson.** (Comptes Rendus, 136. pp. 1664–1666, June 29, 1903.)—The author describes the preparation of certain lead derivatives of the fatty acids. The following thermochemical data are given: For lead tetracetate, $Pb(C_2H_3O_2)_4$ (solid) $+ Aq = PbO_2, nH_2O + 4C_2H_4O_2$ (dissolved) $- 2·75$ cals.; for lead tetrapropionate, $Pb(C_3H_5O_2)_4$ (solid) $+ Aq = - 4·9$ cals. It appears that these compounds first dissolve in water with strong absorption of heat, and that the solutions then decompose with evolution of heat. T. H. P.

1464. *Points of Fusion of Oxygen and Nitrogen.* **T. Estreicher.** (Acad. Sci. Cracovie, Bull. 10. pp. 831–844, Dec., 1903.)—The author finds that the melting-point of oxygen is 46° A., and the vapour pressure at this point 0·9 mm. of mercury. The melting-point of "chemical" nitrogen (from sodium nitrite and ammonium chloride), is 62·79° A., and the melting pressure 93·5 mm. For "atmospheric" nitrogen the numbers are 62·56° A. and 90·2 mm. From the lowering of the freezing-point of nitrogen by argon, the author calculates the molecular depression of nitrogen to be about 5·39°, and the latent heat of fusion 14·49 cals. or 60·44 joules. A. F.

1465. *Efficiency and the Second Law of Thermodynamics.* **H. Friedenthal.** (Phys. Zeitschr. 4. pp. 425–426, May 1, 1903.)—The author supports his own views as against v. Wesendonck's criticisms [see Abstract No. 1405 (1903)], which are ascribed to misunderstanding of the position held. R. E. B.

1466. *A Physical Constant of Dissolved Substances.* **A. Colson.** (Annal. Chim. Phys. 28. pp. 276–288, June, 1903.)—Let L denote the heat of solution of a given mass of a salt in a given quantity w of water. At any definite temperature this will be a function of w. Suppose that $\frac{\delta L}{\delta w}$ always has the same sign. Then it follows that if we plot L as a function of temperature for different values of w, one for each curve, we shall get a series of curves which intersect at a common point. At this temperature the heat of dilution (between any two of the values of w for which the curves were plotted) will be zero. The author terms this temperature the *dead point.* Some salts exhibit a dead point, others do not. Thus NaCl and KNO_3 do, whilst $Na_2SO_4 . 10H_2O$ and $NaHSO_4$ do not. F. G. D.

1467. *Kinetic Theory of Gases.* **J. H. Jeans.** (Phil. Mag. 6. pp. 720–722, Dec., 1903.)—A reply to Burbury's criticism of his paper [see Abstract No. 558 (1903)], and a justification. R. E. B.

1468. *Heat Absorbed in the Electrolysis of Salts and the Principle of Maximum Work.* **D. Tommasi.** (Elektrochem. Zeitschr. 10. pp. 221–222, Jan., 1904.)—Finding that Berthelot's principle does not apply to electrolytic phenomena any more than to other phenomena, the author proposes a "Principle of Least Work," which he states as follows: "That chemical reaction which requires for its starting the least expenditure of energy will always tend to occur, quite apart from the heat evolved or absorbed in this reaction once it is started." Doubtless an equally victorious career awaits this theorem. F. G. D.

1469. *Critical Mixing-point of Two Liquids.* **J. P. Kuenen.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 387–392, Jan. 21, 1904. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, Dec. 19, 1903. University College, Dundee.)—From theoretical considerations the author arrives at the conclusion that the critical mixing-point of two liquids does not coincide with a point of maximum vapour-pressure, if such a point exists; but the latter point may sooner or later at some distance from the critical point be enclosed inside the three-phase equilibrium; in the critical point the liquid branch of the saturation curve in the p-x diagram has a point of inflexion with a tangent parallel to the x-axis. T. H. P.

1470. *Influence of Gravitation on the Plaitpoint Phenomena of Binary Mixtures.* **W. H. Keesom.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 593–597, Feb. 25, 1904. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, Jan. 30, 1904. Communication from the Physical Laboratory at Leiden.)—A theoretical treatment with special reference to mixtures of oxygen and carbon dioxide. [See Abstract No. 581 (1904).] H. H. F. H.

SOUND.

1471. *Pressure of Sound Waves and Absolute Measure of Sound Intensity.* **W. Altberg.** (Ann. d. Physik, 11. 2. pp. 405–420, May 14, 1903. Physik. Laborat. d. Univ., Moskau, Aug., 1902.)—After referring to the work of Dvorak and Raleigh, the author describes his experiments. He employs as receiver a zinc plate which contains a piece of wood moving freely in a cylindrical aperture and attached to a delicate torsion balance. A Kundt tube is the source, and a Wien manometer is employed. Tables of figures are given. The investigation shows that the pressure upon a reflecting wall is completely analogous to the pressure of light waves. By measurement of the pressure the intensity of the sound waves can by the Rayleigh method be calculated in absolute measure. J. W. P.

1472. *Sound-velocity in Tubes.* **J. Müller.** (Ann. d. Physik, 11. 2. pp. 331–354, May 14, 1903. Dissertation at Bonn Physical Institute.)—The velocity is, according to Helmholtz and Kirchoff, given by $a\left(1 - \frac{\gamma}{2r\sqrt{n\pi}}\right)$, where a is the velocity in free air, r the radius of the tube, n the frequency of the note, and γ a constant. The author (using apparatus essentially the same as Kayser's) investigates this formula, and finds—(1) that it has no general validity; (2) that in a tube the velocity depends on the material, and γ is not really a constant. J. W. P.

REFERENCES.

1473. *Microphonic Characteristics of Gaseous Jets.* **A. Fiorentino.** (N. Cimento, 5. pp. 391–401, June, 1903.)—Historical *résumé* of the theory of sensitive flames. Exploration of the pressures at different points of a minute rat-tail jet of gas, not burning but exposed to air-waves from a source of sound, produces in the exploring tube differences of pressure corresponding to Rayleigh's transverse oscillations of the jet; and these by means of a trumpet can be made to reproduce the original sound with great loudness. The point at which this effect is best obtained is just below the point at which the jet begins to lose its clear cylindrical form: and the point to which the exciting air-waves should be brought is immediately above the nozzle. New sensitive flames are described, which lose luminosity when sound is produced. A. D.

1474. *Equation of Decay of Sound in a Room.* **W. S. Franklin.** (Phys. Rev. 16. pp. 372–374, June, 1903.)—A mathematical consideration in which agreement with previous experimental result is obtained. The causes of the energy dissipation are pointed out. J. W. P.

1475. *Tracing Speech Curves.* **E. W. Scripture.** (Amer. Journ. Sci. 15. pp. 447–449, June, 1903.)—Description of a machine for writing on a greatly enlarged scale the curves recorded on celluloid phonograph cylinders (by H. Lioret, Paris). A. D.

1476. *An Acoustic Property of Manometric Flames.* **Q. Majorana.** (N. Cimento, 7. pp. 35–37, Jan., 1904.)—An ordinary manometric flame does not reproduce the sound which causes the variations in its luminous intensity, but it may be made to do so by directing a jet of air upon it; it then gives an exact reproduction of the original sound, and, where it reproduces the voice, becomes a true speaking flame. D. H. J.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

1477. *General Problem of Electrodynamic Induction in the Case of an Infinite Conducting Plane.* **T. Boggio.** (Accad. Sci. Torino, Atti, 38. 10a. pp. 298–316, 1902–1903.)—The potential in this paper is the retarded potential, which in free space satisfies the condition—(I.) $\Delta_2 - A^2 d^2/dt^2 = 0$, $\frac{1}{A}$ being the velocity of light. Let F denote the electrostatic potential, U, V, W the components of vector potential of the given field. Then we have the further condition—(II.) $A\,dF/dt + dU/dx + dV/dy + dW/dz = 0$. And if F_1, U_1, V_1, W_1 denote the corresponding quantities for the induced phenomena on the conducting plane σ $(z = 0)$, we have the further conditions—

$$dF_1/dx + A dU_1/dt - h dU_1/dz = -(dF/dx + A dU/dt)$$
$$dF_1/dy + A dV_1/dt - h dV_1/dz = -(dF/dy + A dV/dt),$$

in which h is a constant depending on resistance. The object is to determine F_1, U_1, V_1, W_1 to satisfy these conditions. The writer makes use of a theorem of Picciati's, that there exists one only function of x, y, z which has assigned values over the plane $z = 0$, and satisfies I for all real values of x, y and positive z. Evidently there must be one such function, and if ϕ be such function, $\phi + \phi'$ another, ϕ' must satisfy the conditions $\phi' = 0$ on the plane $z = 0$, $\Delta_2\phi' = 0$ at all points in the space $z > 0$. Therefore $\phi' = 0$ everywhere. The writer then first assumes F, U, V, W to be of the form fF', uU', &c., in which f, u, v, w are functions of t, the time, only, F', U', &c., functions of x, y, z only, and independent of t. And we may assume as a particular case $f = u = v = w = e^{iat}$ $(i = \sqrt{-1})$. It is then found that if $F_1 = e^{i\alpha t}F_2$, in which F_2 is a function of x, y, z only, we must have $\alpha = a$ or $F_1 = e^{iat}F_2$. Suppose $dF'/dx + iaU' = p$, $dF'/dy + iaV' = q$, then p and q are known. And it is shown that F_2, U_2 have to satisfy on $z = 0$

$$\frac{dF_2}{dx} + iaU_2 - h\frac{dU_2}{dz} = -p \qquad \frac{dF_2}{dy} + iaV_2 = h\frac{dV_2}{dz} = -q.$$

But if P, Q are quantities which satisfy I, and have the values $-p$, $-q$ on the plane $z = 0$, it follows from Picciati's theorem that $\frac{dF_2}{dx} + iaU_2 - h\frac{dU_2}{dz} = P$, $\frac{dF_2}{dy} + iaV_2 - h\frac{dV_2}{dz} = Q$, everywhere where $z > 0$. From these equations he eliminates U_2, V_2 by differentiation, and obtains F_2 in the form

$$F_2 = e^{-ibz}\int_z^{\infty} e^{ibz}\,dz \int_z^{\infty} \left(\frac{dP}{dx} + \frac{dQ}{dy}\right) dz,$$

and U_2, &c., are found by the same method. This is a solution for the case in which F, U, &c., have the values $e^{-iat}F'$, &c. The solution is afterwards extended to the general case of any given electromagnetic field by means of Fourier's series, $F = \Sigma_{0m}^{\infty} e^{-imt}F'_m$, &c.

S. H. B.

1478. *The Faraday-Maxwell Tensions.* **G. Bakker.** (Ann. d. Physik, 13. 3. pp. 562–572, Feb., 1904.)—The author says that the tensions in an electric, magnetic, or electromagnetic field, discovered by Faraday, and mathematically expressed by Maxwell, are often identified with the surface forces which express the state of deformation of an elastic body, and that this identification is incorrect. Maxwell isolates a portion of his electromagnetic field, and reduces the action of the rest of the field on this isolated portion to a surface integral over the bounding surface, represented by the vectors—

$$p_{xx}=\frac{1}{8\pi}\left\{\left(\frac{dV}{dx}\right)^2-\left(\frac{dV}{dy}\right)^2-\left(\frac{dV}{dz}\right)^2\right\},\ p_{xy}=\frac{1}{4\pi}\frac{dV}{dy}\frac{dV}{dz},\ \text{\&c.}$$

The x component of force on the isolated portion is—

$$X=\int\left(\frac{\partial p_{xx}}{\partial x}+\frac{\partial p_{xy}}{\partial y}+\frac{\partial p_{xz}}{\partial z}\right)d\tau\ (2),$$

where $d\tau$ denotes an element of volume, which is also often reduced to $X=\int(p_{xx}\cos\lambda+p_{xy}\cos\mu+p_{xz}\cos\nu)dS$ (3) over the bounding surface. He then considers the example of a homogeneous fluid gravitating sphere of density ρ and radius R at rest. For such a sphere the pressure at the centre is $p_M=\frac{z}{3}\pi f\rho^2R^2$, f being the constant of gravitation. And if g_0 be the force of attraction on the surface, this may be put in the form $p_\mu=\frac{3}{8\pi f}g_0^2$. On this he remarks that, f being very small, p_M at the centre should be very great. But does not g_0 contain f as a factor ? Mathieu, in his theory of the potential, says that the molecules of a substance under elastic forces undergo a finite change in their directions, tending to place themselves along the lines of force. The author expresses his own opinion that it is not necessary to go so deep into the matter in order to explain how Maxwell's forms are inapplicable. Another example he gives of a homogeneous fluid gravitating sphere with density ρ and radius R at rest, and he says that the potential is given by Dirichlet ("On Forces Acting according to the Law of the Inverse Square," p. 17) as $V=\frac{2\pi}{g}f\rho(x^2+y^2+z^2)-2\pi f\rho R^2$. The reader will turn to Dirichlet for an explanation of this formula. The author says it leads to the result $\frac{\partial(p_{xx}+X_x)}{\partial x}+\frac{\partial(p_{xy}+X_y)}{\partial y}+\frac{\partial(p_{xz}+X_z)}{\partial z}=0$, which, however, does not necessarily involve $p_{xx}+X_x=0$, &c. The distinction is discussed. As a third example he considers the case of dilatation of an isotropic body, making use of Chree's formula—

$$\partial v=\frac{1}{3\lambda+2\mu}\int(Xx+Yy+Zz)d\tau+\frac{1}{3\lambda+2\mu}\int(Fx+Gy+Hz)ds,$$

where X, Y, Z are volume forces, F, G, H surface forces. S. H. B.

1479. *Stresses in a Magnetostatic Field.* **G. W. Walker.** (Phil. Mag. 7. pp. 399–402, April, 1904. Communicated by the Physical Society, Feb. 26, 1904.)—The usual methods of analysis lead to a system of stress in a magnetostatic field exactly analogous to the Maxwellian system of stress in an electrostatic field. These are here called stresses of the electrical type. The author criticises the conclusions of G. T. Walker ("Aberration and the Electromagnetic Field," p. 76), who obtains for the magnetostatic field an expression which differs from the stresses of electrical type in the superposition of a hydrostatic pressure $\frac{1}{8\pi}\left(\frac{\mu}{\mu_0}-1\right)H^2$, this being supposed confirmed by an experiment due to Quincke, which is regarded as crucial. The experiment was as follows: A thermometer-shaped vessel with capillary tube attached was filled with a solution of ferric chloride, so that the liquid stood at a certain height in the capillary tube. The bulb was placed between the poles of a strong electromagnet, and when the magnet was excited the level of the liquid in the capillary tube fell. The bulb was in the form of a disc, the direction of thickness being parallel to the lines of force. The view under criticism is that the supposed hydrostatic pressure would cause the liquid to contract and the bulb to expand slightly, whereas the stress of electric type would only give a very small force at the surface of the liquid in the capillary tube which would make the column rise. It is here objected that this view takes no account of the surface forces due to stress of electrical type, which must exist at the surface separating the liquid in the bulb from the glass. It is then shown that the stresses of electrical type give a force per unit area, directed outwards on the inner surface, exactly equal to the hydrostatic pressure in the liquid in the theory under criticism. It is thus contended that so far from being crucial in favour of the theory of G. T. Walker as to a superposed hydrostatic pressure, Quincke's experiment gives no support to it and is readily explained by the stresses of electrical type.

E. H. B.

1480. *Dielectric Capacity of Atoms.* **W. Sutherland.** (Phil. Mag. 7. pp. 402–405, April, 1904.)—Denoting by K_1 the dielectric capacity of the stuff of the atom and by N_1 the refractive index of the stuff, B being the value of a gramme-atom of the ion, and ν being 1 for monad atoms and 2 for the dyads; the author finds (1) that K_1 does not always equal N_1^2, and (2) that $K_1 B^{\frac{1}{3}}/\nu$ is practically a constant for the following elements: Li, Na, K, Rb, Cs, Mg, Ca, Sr, Ba, Zn, Cd, Ag, Pb, F, Cl, Br, I. E. H. B.

1481. *Electromagnetic Phenomena in System moving with Velocity less than that of Light.* **H. A. Lorentz.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 986–1009, May, 1904.)—The necessity of a general treatment is shown, where not only the second but also higher powers of the velocity are retained. The author developes the general equations with moving axes and transforms them by the aid of new vectors; as one special case an electrostatic system is considered and compared with a similar one at rest. As a second case the author treats that of an element with an electric moment. The following hypotheses are made: The dimensions of the electrons are diminished *kl* times in the direction of motion and *ll* times in perpendicular directions, and also that the forces between uncharged material particles or electrons are influenced by a translation in the same way as the forces in the electrostatic system considered. These are then applied to electrons moving with a constant velocity or one which only changes slowly. They then have a longitudinal and a transverse electromagnetic mass, and are supposed to have no real mass. A consideration of transparent media leads to the conclusion that the transverse dimensions of the electrons are unaltered in them. From this theory it follows that interference, diffraction, or polarisation would not be altered by translation. The values of the two electromagnetic masses are calculated from Kaufmann's determinations with radium rays, and the results compared with Abraham's and Runge's calculated values. Lastly, the magnitude of the possible effect in an experiment of Trouton's [see Abstract No. 1701 (1902)] is shown to be too small to be detected. H. H. F. H.

1482. *Magnetic Effect of Electric Convection.* **H. Pender** and **V. Crémieu.** (Soc. Franç. Phys., Séances, 3. pp. 136–162, 1903. Also Journ. de Physique, 2. pp. 641–666, Sept., 1903.)—Negative results having been obtained by Crémieu [see Abstracts Nos. 83 and 345 (1903)] and positive by others, a joint investigation by Pender and Crémieu was arranged by the University of Paris, Johns Hopkins University, the Institute of France, and the Carnegie Institution. The conditions for convection experiments were (1) that the charge shall with certainty be carried along by the moving conductor, (2) that this charge alone shall act upon the apparatus for detecting the magnetic effect, if any, and (3) that during convection the charge shall vary not at all or only very slightly. Of these, subsidiary phenomena (fully discussed) have prevented certainty as to the attainment of (3), but collaboration has resulted in realising (1) and (2). Now, the convection of charge by a metallic disc, rotating in its own plane between two fixed armatures parallel to this plane, does produce a magnetic field in the predicted direction and in accord, within 10 per cent., with the theory; and charged sectors, insulated and mobile in their own plane, without any fixed armature, do produce magnetic effects in the direction and of the order required by the theory of electric convection. Incidentally the paper contains an exhaustive account of the difficulties and causes of error encountered, including the effect in Crémieu's experiments of a thin layer of caoutchouc on the rotating disc and its armature, which affected his results. A. D.

1483. *Measurements of the Electric Conductivity of the Air from Balloons.* **H. Gerdien.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 6. pp. 383–399, 1903. Geophysikalisches Institut, Göttingen, Dec., 1903.)—Together with H. Elias, F. Linke, and E. Wiechert, the author has made four balloon ascents from Göttingen and Berlin in summer and autumn, reaching once an altitude of 7,100 m., in order to determine the ionisation and ionic velocity with an H. Ebert aspiration apparatus, improved by himself; it resembles the tubular condenser used by J. J. Thomson for the investigation of Röntgenised air. In order to prevent static charges on the balloons, Linke has applied water squirts, and as the fine ballast sand was frequently carried into the balloon, producing adsorption of the ions, liquid ballast is to be tried. Two simultaneous observations seem to be necessary, the one in a weak, the other in a strong condenser field. The ionisation amounts to about 1 electrostatic unit per cub. cm., as found by Ebert and by Lüdeling, at all altitudes. There is, however, a vertical current of about 10^{-16} amp./cm.^{2}, and the specific ionic velocity, varying between 1 and 3 cm./sec. in a field of 1 volt/cm., seems to increase with the altitude. H. B.

1484. *Electricity Dispersion in the Free Atmosphere.* **P. B. Zölss.** (Phys. Zeitschr. 5. pp. 106–108, Feb. 15, 1904.)—A summary of 2,867 measurements made, with Elster-Geitel apparatus, by F. Schwab from a window of the Kremsmünster Observatory, 11·6 m. above ground, in the period December, 1901, to April, 1903. The mean dispersion of the noon observations is 1·32 (1·33 at Wolfenbüttel); the extremes are 5·83 (Föhn wind) and 0·14 (mist). The annual minima both for $a-$ and $a+$ occur in January, the maximum for $a-$ in June, for $a+$ in April. In winter the dispersion has a double diurnal period with two maxima (soon after noon and at night) and two minima (sunrise, soon after sunset); in summer the diurnal period is simple when days without precipitation are alone considered, the average values of q increasing with increasing potential gradient (Goeckel); but q is subject to rapid changes. The dispersion increases with increasing wind velocity, with solar radiation and temperature, with high vapour-tension and low relative humidity, and finally, with the amplitudes of the diurnal variations in magnetic declination; there is also similarity in the yearly periods of dispersion and declination, but no distinct relation to the magnetic intensity. H. B.

1485. *Atmospherical Radio-activity in High Latitudes.* **G. C. Simpson.** (Roy. Soc., Proc. 73. pp. 209–216, March 23, 1904.)—A record of observations made on the radio-activity of the air at Karasjoh (Norway, 69° 20′ N., 25° 30′ E.) by Elster and Geitel's method, in which the radio-activity of a wire is determined after it has been stretched out for a time in the open air while charged to a high negative potential. The results of observations made three times a day for four weeks in November and December, 1903, are given in tables. These observations show that the radio-activity is much greater than in lower latitudes, the mean for the month being nearly six times as great as the mean for the year obtained by Elster and Geitel in Germany. In the daily observations the mean value is greatest for the evening. The measurements show no direct relation between the radio-activity and the potential gradient, nor does the barometric pressure appear to have any great influence. The values of the activity were much less during the presence of clouds than with a clear sky. During the time of the observations the sun did not rise above the horizon. The place of observation is 140 m. above sea-level, the ground being hard frozen to a great depth and covered with a coating of snow to an average depth of over 2 ft. Sudden changes in radio-activity were sometimes observed. There is some difficulty in reconciling these observations with Elster and Geitel's view that the activity is entirely due to a diffusion of a radio-active emanation from the soil. J. J. S.

DISCHARGE AND OSCILLATIONS.

1486. *Sign and Magnitude of "Contact" Electrification.* **J. Perrin.** (Comptes Rendus, 136. pp. 1441–1443, June 15, 1903.)—The author has previously shown that electric osmosis affords a convenient and general means for studying electrification by contact in the interior of a liquid, and that such osmosis is only readily produced in liquids which have high dielectric constants and are hence good ionisers. He now finds that the direction and magnitude of the osmosis may be determined by infinitesimal traces of certain ions. The action of acids and bases—*i.e.*, of hydrogen and hydroxyl ions—is extraordinarily great, and the osmosis indicates their presence with a sensitiveness even greater than that of indicators. Matter electrically neutral in neutral water will become positively charged in water containing 1 mol. of acid per 5,000,000 mols. of water, which is purer than ordinary distilled water; equally feeble basicity produces a negative charge. It hence becomes necessary to eliminate the influence of carbon dioxide dissolved from the air. Silver ions and, to a less extent, thallium ions also charge the material of the diaphragm positively, while the positive ions Na, K, Li, NH_4, and the negative ones Cl, Br, I, NO_3, ClO_3, CH_3CO_2, CH_2ClCO_2, CCl_3CO_2, have but slight action. T. H. P.

1487. *Sign and Magnitude of "Contact" Electrification.* **J. Perrin.** (Comptes Rendus, 137. pp. 513–514, Oct. 5, 1903.)—The author describes investigations on the sign and magnitude of the electrification produced by contact of a solid with a liquid, by noting the electric osmose produced in the liquid by an equal electric charge of opposite sign. In the case of aqueous solutions the hydrogen and hydroxyl ions are alone active, and each charges the immersed solid with electricity of its own kind. The activities of the hydrogen and hydroxyl ions are diminished by the presence of negative and positive polyvalent ions respectively, and this minifying action increases with the concentration of these polyvalent ions. These views are supported by the facts that (1) colloids probably exist in solution as electrically charged granules (Picton and Linder); (2) the sign of this charge is extremely sensitive to the influence of traces of acid or alkali (Hardy); (3) the coagulation of colloids is brought about most readily by electrolytes able to yield a polyvalent ion charged oppositely to the colloidal granules, and is the more effectual the greater the charge of the ion (Schulze and Hardy). T. H. P.

1488. *Contact Electrification and Theory of Colloidal Solutions.* **J. Perrin.** (Comptes Rendus, 137. pp. 564–566, Oct. 12, 1903. Compare preceding Abstract.)—A colloidal solution is supposed to represent a suspension of ultra-microscopic and electrically charged particles (molecular aggregates). Under definite conditions the particles have a certain stable size, for which the electric charge just compensates the aggregating influences of surface tension and cohesion. The electric charge of a particle hinders its further growth by the repulsion of the electrons. If the contact electricity between the liquid and the colloidal particles is increased or diminished, the size of the particles of the equilibrated system is respectively diminished or increased. If, however, the value of the charge becomes less than a certain definite limiting value, the particles aggregate and coagulation sets in.

T. H. P.

1489. *Electrical Conductivity produced by Hot Conductors.* **O. W. Richardson.** (Roy. Soc., Phil. Trans. 201. pp. 497–549, July 20, 1903. Roy. Soc., Proc. 71. pp. 415–418, April 30, 1903.)—Platinum, carbon, or sodium is heated to redness in a vacuum, and the negative leak from it is studied. On the corpuscular theory of conduction in metals a formula of the type $A\theta^{\frac{1}{2}}e^{-\frac{b}{\theta}}$ is deduced as giving the current at temperature θ, and this is found to fit the experimental results. From the constants A and b involved the number of corpuscles per c.cm. can be deduced, as well as the work required to drag a corpuscle from the metal. Corpuscular currents of the order 1 amp. per sq. cm. area were obtained in the case of carbon. The experiments completely explain the Edison effect in incandescent lamps. At high temperatures the conductivity of the vacuum may be quite comparable to that of the filament. R. S. W.

1490. *Sparking Potential in Gases.* **W. R. Carr.** (Roy. Soc., Phil. Trans. 201. pp. 403–433, July 8, 1903. Roy. Soc., Proc. 71. pp. 374–376, April 7, 1903. Abstract.)—Paschen's law, viz., that with a given spark potential the pressure at which discharge occurs is inversely proportional to the distance between the electrodes, is shown to hold both above and below the critical pressure (*i.e.*, the pressure for which the sparking potential is a minimum for a given spark-length). The minimum sparking potential is a physical constant for a gas, being independent of pressure and spark-length, and is a property of the atom rather than the molecule. It may be calculated for a selected gas by the application of a simple additive law. R. S. W.

1491. *Duddell's Currents.* **M. La Rosa.** (N. Cimento, 7. pp. 5–17, Jan., 1904.)—The effect of varying the inductance, capacity, and resistance of the shunt circuit in Duddell's experiment on the humming arc is investigated experimentally. The frequencies under various conditions are compared with those for an approximately sinusoidal current, in which case the periodic time is $2\pi\sqrt{LC}$. The actual current curve is asymmetric, and has been discussed by O. M. Corbino [see Abstract No. 874 (1904)]. An ammeter is placed in the main circuit, the amplitude of the current in the shunt circuit being determined by means of a Braun tube. The ratios of the periodic times are observed by tuning the wire of a monochord to the notes emitted in the various cases. The influence of resistance, inductance, and capacity is observed in three sets of experiments, and the following conclusions are drawn: (1) The amplitude of the oscillatory current is independent of the resistance of the shunt circuit until this reaches a value 2·5 ohms, when the oscillations cease. (2) The change of amplitude with inductance does not follow any simple law; it increases with diminishing inductance, and its change for a given alteration in the inductance is less, the smaller the capacity and the greater the principal current. (3) When the principal current is small the amplitude tends to vary inversely as the square root of the inductance. (4) The amplitude does not vary in a simple manner with the capacity. It increases with increase of capacity, and its changes are greater the smaller the self-induction, and the less the principal current. (5) When the principal current is small the amplitude tends to vary inversely as the cube root of the capacity. On Corbino's hypothesis the author obtains the relation—

$$I_0 = \sqrt{I^2 + \frac{C}{L}V^2},$$

where I_0 and I are the actual amplitude and that for sinusoidal current, and V the p.d. between the ends of the shunt circuit, and he shows that his results are in accordance with this equation. S. G. S.

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1492. *Kathode Disintegration.* **L. Holborn** and **L. Austin.** (Phys. Tech. Reichsanstalt, Wiss. Abh. 4. pp. 101–114, 1904.)—The authors find that the loss in weight of a kathode with the glow discharge can be represented by the equations $y = 0·00163\ A/n\ (V–495)$, or $y = 0·00187\ A/n\ (V–495)$, where "$y$" is the loss in weight of the kathode, expressed in milligrammes $\times 10^{-2}$, V is the kathode fall of potential, A is the atomic weight of the metal, and "n" the valency. The experiment in each case lasted thirty minutes, and the current strength used was $0·6 \times 10^{-3}$ amp. Potentials were used varying from 350 to 2,500 volts. Thus the curve representing the connection between the loss in weight of the kathode and the potential is a straight line; all the curves for the different metals cut the potential axis at $V = 495$ as they become asymptotic at that point. With higher potentials the results obtained were irregular. If the slopes of the various lines obtained are calculated it is found that the tangent of the slope bears a simple relation to the atomic weight of the metal. The metals must, however, be divided into two classes, corresponding to the above two equations; to the first class belong silver, platinum, iridium, copper, and nickel, and to the second class silver, bismuth, palladium, antimony, and rhodium. The members of each class lose an equivalent weight for the same potential. No explanation is so far possible of the fact that silver belongs to both classes. In the case of gold the values calculated on the assumption that gold is monovalent are all greater than the observed values, and the difference increases with increasing potential fall at the kathode. Possibly one must assume that a portion of the atoms which fly away have a valency less than one. Metals such as zinc, cadmium, lead, and tin, which are readily oxidised, were also investigated, but the oxidation which takes place complicates the results; in the case of zinc, with low potentials, results were obtained which were in approximate agreement with the above equations. Aluminium, iron, and steel hardly suffer any loss in weight. The results obtained by Granquist (Öfvers. af. K. Vetenskaps. Ak. Förhandl. p. 709, 1898) are in agreement with an equation similar to the ones given. The potential of the kathode under the glow discharge depends on the gas pressure, the current density, and also on the arrangement of the discharge tube. Experiments in an atmosphere of hydrogen did not lead to any regular results. T. S. P.

1493. *Ionisation produced by Impact of Negative Ions from Incandescent Carbon.* **J. Stark.** (Phys. Zeitschr. 5. pp. 51–57, Jan. 15, 1904.)—An incandescent carbon filament is used as kathode, which when glowing gives off negative ions. On account of the presence of these ions a current can pass. When a critical potential difference is reached the velocity of these ions is sufficient to ionise the gas in the tube, which effect greatly increases the conductivity. The tube contains nitrogen and mercury vapour. The latter is ionised at an earlier stage than the former, an upward bend in the current curve taking place when a p.d. of 11 volts between the terminals is reached. At 27 volts a much greater rise is observed, which the author ascribes to the ionisation of the nitrogen produced by the impact of ions, and which he calls the ionisation voltage for nitrogen. If the pressure is so small that some of the ions given off by the carbon reach the walls of the vessel without meeting with nitrogen molecules, the secondary ionisation is reduced, and a diminution in the current is observed. Further, the negative glow does not occur until the p.d. is sufficient to give the negative ions liberated by the carbon sufficient kinetic energy to ionise the gas on impact. The discontinuous spectrum is produced when this p.d. is reached. The same applies to the p.d. required to produce the bright layers of the striated column. The author found that with 27 volts the negative glow, and with 58 volts two striations, are produced; with 300 volts eight striations. [See also Abstract No. 87 (1903).] S. G. S.

1494. *Glow Discharge at Atmospheric Pressure.* **J. Stark.** (Phys. Zeitschr. 4. pp. 535–537, July 1; 605–608, Aug. 15; and pp. 715–717, Oct. 15, 1903.) **W. Kaufmann.** (Phys. Zeitschr. 4. pp. 578–580, Aug. 1, and pp. 653–655, Sept. 15, 1903.)—An acrimonious discussion as to the alleged different results obtained by the two authors. **W. Kaufmann.** (Phys. Zeitschr. 5. pp. 57–58, Jan. 15, 1904.) **J. Stark.** (Phys. Zeitschr. 5. pp. 96–98, Feb. 15, 1904.)—Experiments were undertaken by Kaufmann to test the theory of J. Stark, as to the effect of the temperature of the electrodes on the relation between the potential difference between the electrodes and their distance apart. The electrodes are U-shaped platinum wires, the wire being 60 mm. long and 0·5 mm. in diam. The distance apart is measured by means of a micrometer which carries one of the electrodes, the instant of contact being determined by a telephone. It was found that the p.d. diminished with diminishing length of gap, down to the smallest distances measurable, and even when the kathode was artificially heated by an electric current the same effect was still observed. The author claims that these experiments disprove the theory of J. Stark, that for a small gap the p.d. is independent of the length of gap, and that the range throughout which this independence holds increases with the temperature of the kathode; and further, that Stark's experiments which bear out his theory are untrustworthy. Stark then, in the second paper, claims, in reply to Kaufmann, that in his experiments the kathode is at a higher temperature than in Kaufmann's, and that for Kaufmann's experiments in which higher temperatures were used the results approximate to his own. One marked difference in the results he attributes to impurity in the electrodes. He states that traces of calcium oxide on the platinum greatly reduce the p.d. for given current and length of gap (at small p.d.), owing to the negative ions given off at the kathode. S. G. S.

1495. *Validity of Dalton's or Henry's Law for the Absorption by Different Liquids of the Emanations from the Freiburg Water-supply and from Radium.* **H. F. Rausch von Traubenburg.** (Phys. Zeitschr. 5. pp. 130–134, March 1, 1904. Phys. Inst. der Freiburger Universität.)—The results of the investigation are summarised as follows: (1) Tap-water gradually loses its ionising properties, but (2) these can be restored by leading in air from a water-jet pump. (3) All the liquids hitherto investigated can be rendered active in this way, but the hydrocarbons possess this power to a particularly large extent. (4) The ionising power of water is dependent on the presence of a dissolved radio-active emanation which obeys Dalton's or Henry's law. (5) The absorption-coefficient of different liquids for this emanation can be deduced with the help of the ordinary gas equations. (6) The radium emanation behaves in much the same way, with regard to its absorption by different liquids, as the emanation from the Freiburg water-supply. The following table is given for the leakage in volts per hour produced by different liquids after saturation with air from the water-jet:—

Copper Sulphate	81·4	Alcohol	2240
Distilled Water	139	Light Petroleum	2250
Inactive Tap-water	152	Nitro-benzene	2510
Paraffin Oil	2010		

T. M. L.

1496. *Ionisation produced by Röntgen Rays.* **R. K. McClung.** (Nature, 69. pp. 462–463, March 17, 1904. Cavendish Laboratory, Cambridge, March 12.)—A reference to experiments of the author which show that the relative ionisation in different gases depends upon the type of rays used. The ionisation of each gas was balanced against that in air. When the pressure of the gas in the Röntgen-ray bulb was varied, thereby varying the "hardness," or penetrating power of the rays, it was found that in the case of gases in which the ionisation is greater than in air, the ionisation in these gases decreases relatively to that in air as the rays become harder. In hydrogen, in which the ionisation is much less than in air, the ionisation increases, relatively to that in air, with the increase of the hardness of the rays. [See also Abstract No. 1124 (1904).] J. J. S.

1497. *Analysis of Tesla Condenser Discharges.* **J. Härdén.** (Phys. Zeitschr. 4. pp. 461–465, May 15, 1903.)—An experiment due to Andrews is here described, in which an alternator of 100 volts and 58 ∿ is connected to a transformer which raises the potential to 5,000 volts. To this a condenser is connected, which discharges through an air-gap. In order to analyse the discharge the primary of another transformer is inserted between the condenser and the air-gap. In series with the secondary of this transformer is a pair of brushes, each touching a ring. By this means a discharge is sent through a vacuum tube whose ends are connected to the rings so that the tube may be revolved at a high speed. By taking photographs of the vacuum-tube discharge while the tube is revolving, a number of bundles of bright radial lines are shown, each bundle corresponding to one oscillatory discharge. It was found that six such discharges occurred in one complete period of the alternator, three corresponding to the positive and three to the negative current. [Compare Pierce, Abstract No. 1140 (1904).] E. H. B.

1498. *Circularly Polarised Electric Waves.* **A. Artom.** (Elettricista, Rome, 12. pp. 129–133, June, 1903.)—Electrical oscillations take place in two circuits in parallel, one circuit having capacity C, and the other inductance L and resistance r. It is shown that the two currents are equal in amplitude and differ in phase by 90° when $2\pi n\mathrm{L} = r$, and $4\pi^2 n^2 \mathrm{LC} = 1$. The sparks take place between three knobs arranged in the form of a right-angled triangle. The effect of the rotating magnetic field on small conducting bodies could not be observed; but the effect of the rotating electrical field on a small light bell of glass supported on a glass point and charged by means of a coil with Wehnelt interrupter was observed. When the circuits are so changed that the direction of rotation of the electric field is changed, the direction of rotation of the glass bell changes. Also, an electric resonator was found to spark in any position when arranged so as to be varied in azimuth about the beam from the oscillator. [See also Abstract No. 1232 (1903).] S. G. S.

1499. *Experiments on Imperfect Contacts.* **A. Fisch.** (Journ. de Physique, 3. pp. 350–354, May, 1904.)—The author first examines some filings coherers, using alternating and direct-current to produce the coherer action instead of waves, the p.d. applied being gradually increased, and the resistance measured. Curves plotted from these measurements show that the effect produced by an alternating current is greater and commences at an earlier value than with a direct-current. Dealing, then, with single-point coherers he finds that the curves can take either of the two characteristic forms according to the way the current is increased, he also considering that a greater critical voltage can be obtained if the surfaces are much oxidised [see Robinson, Abstract No. 1174 (1904)]. It is found that plotting the values of the current as abscissæ and p.d. as ordinates, the characteristic curve has three parts: (1) The p.d. increases to the critical value (equilibrium p.d.); (2) the p.d. remains constant; (3) the p.d. begins to rise again. In measuring the resistance in the region (1) with a weak current, the resistance is found to have returned to its original value. In other parts of the curve, however, the resistance diminishes still further as a result of this current. A table of critical valves (equilibrium-p.d.'s of Robinson) is then given, paraffin oil and glycerine giving high values which are considered to be due to their viscosity. No abnormal effect was observed in the case of water. L. H. W.

1500. *Use of Nickel in the Marconi Magnetic Detector.* **A. L. Foley.** (Phys. Rev. 18. pp. 349–354, May, 1904. Physics Lab., Indiana University, April, 1903. Elect. World and Engineer, 43. p. 1120, June 11, 1904. Condensed.)—The author describes some experiments which he has made with a Marconi detector of the revolving-magnet type, using a Rowland-d'Arsonval ballistic galvanometer in place of a telephone. The core was composed of 26 annealed piano wires, 5 cm. long and 0·063 cm. diam., a 2-mm. spark with aerials 2 m. long being used, without any tuning, and the receiver being placed at various distances 2 to 20 m. away. Readings were taken by short-circuiting the galvanometer and placing the magnet in position, then opening the galvanometer short-circuit and operating the transmitter as long as the deflection was increasing, and the throw observed. Tables are given showing the throws obtained (1) with the magnet placed 10 cm. from the bore and moved one space nearer after each reading, (2) with the magnet in contact with the core and moved away one space after each reading, (3) when the magnet is removed after each reading and the transmitter worked before replacing the magnet, (4) when the magnet is turned over (field is reversed). Curves plotted from these readings show that the sensitiveness depends on the distance and direction of motion of the magnet. When the magnet is near the core, the sensitiveness is greater when the magnet is approaching; when some distance from the core, the sensitiveness is greater when the magnet is receding, there being a maximum, situated at a less distance with the approaching magnet. Curves for the four series show progressively larger changes in the magnetisation caused by the waves. The author then substituted cores containing varying proportions of nickel for the all steel core. These were (1) the original steel core, (2) 10 piano wires and 10 nickel wires 0·082 cm. diam., (3) 2 piano wires and 13 nickel wires, (4) 14 nickel wires. A table of the deflections at different distances between the magnet and each of the cores is given, the magnet having been moved one space and its poles reversed after each reading. The results show that the sensitiveness of the nickel core is about the same as the steel core, but the nickel was more sensitive in strong fields and the steel in weak fields, which was contrary to expectation. The mixed core of iron and nickel gave the best results, the deflection increasing as the magnet approached the core up to the point of contact. The author concludes on the evidence of these experiments that oscillations have the property of decreasing the hysteresis, as stated by Marconi, and intends to try the effect of oscillations upon the hysteresis losses of transformers, &c. L. H. W.

1501. *The Hot Oxide Coherer.* **M. Hornemann.** (Ann. d. Physik, 14. 1. pp. 129–138, May, 1904.)—The author refers to his paper on "Sound at Electric Contacts" [see Abstract No. 1880 (1902)], and the results obtained with an oxidised iron coherer. From this he was led to investigate different oxidised contacts, which, when made of the same material, gave much the same result whether used hot or cold; using, however, lead in contact with a heated oxidised metal such as iron, or, best of all, copper or copper alloy, an exceedingly sensitive coherer was obtained which responded to very small sparks, 12 m. off, without any earth connection or aerial wires, and through several brick walls. On examining the effect with a galvanometer in circuit, the lead being negative and the copper heated, the coherer was found to decohere spontaneously when the exciting spark was sufficiently weak. With a stronger spark it required tapping. From some observations of thermo-e.m.f.'s, which are described but are not conclusive, the author considers that the influence of the waves is to diminish the thermo-e.m.f. L. H. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

1502. *Variation with Pressure in the Dielectric Constant of Glass.* **A. Wüllner** and **M. Wien.** (Ann. d. Physik, 11. 3. pp. 619–635, June 4, 1903. Physik. Inst. d. techn. Hochsch. Aachen, March, 1903.)—In a previous paper the authors have shown that the increase in internal volume of spherical and cylindrical condensers, due to electrostriction, is always smaller than would be expected from the acoustically and mechanically determined values of the coefficient of elasticity. [See Abstract No. 922 (1903).] They consider this effect to be due to a change in the dielectric constant, produced by mechanical strain at right angles to the direction of the electric field. In this paper they have determined this variation by direct observation of the change in capacity of a cylindrical condenser consisting of a glass tube, when the tube is stretched longitudinally. The inner coating of the condenser is a weak solution of sulphuric acid, and the tube is silvered on the outside to form the outer coating. If C is the capacity of the condenser, l its length, and ε the dielectric constant of the glass, it is shown that, $\delta C/C = \delta l/l + \delta\varepsilon/\varepsilon$, and that $k_\epsilon = 1/E_\epsilon - 1/E_l$, where $1/E_\epsilon = (\delta C/C)(1/\delta p)$, p being the tension in the tube. E_l is the elasticity for stretching. It is also shown that $k_e = 1/E_e - 1/E_a$, where E_e is the modulus for electrostriction, E_a that for mechanical strain, and $k_e = -(1/\varepsilon)(d\varepsilon/dp)$. E_e, E_a, and k_e were determined in the previous experiment, and the authors now determine E_ϵ and E_l. The change in capacity is determined by a bridge method, a change of 1/60000 of the whole capacity being determinable. It is then found that the values for k_ϵ and k_e have always the same sign, and are of the same order of magnitude, the differences observed being only of the order of magnitude of the experimental error. The authors thus conclude that the change of dielectric constant produced in glass by tension at right angles to the electric field has always a negative value, and varies in magnitude with different kinds of glass, being least in Thuringian glass and greatest in flint glass. For the latter, $k_e = -6{\cdot}9 \times 10^{-13}$ and $k_\epsilon = -7{\cdot}0 \times 10^{-13}$. S. G. S.

1503. *The Moving-Coil Ballistic Galvanometer.* **M. Donegan** and **W. G. Smith.** (Elect. Engin. 31. pp. 830–833, June 5, 1903. Paper read before the Dublin Local Section of the I.E.E., May 29, 1903.)—The authors compare the use of the suspended coil ballistic galvanometer with that of the suspended magnet instrument, and find that whereas the expression, $Q = \dfrac{HT\left(1 + \dfrac{\lambda}{2}\right)a}{2\pi G}$ applies to the suspended magnet type, the corresponding expression for the suspended coil type is, $Q = \dfrac{K}{BAn}\dfrac{T}{2\pi}\left(1 + \dfrac{\lambda}{2}\right)\theta + \gamma\dfrac{BAn}{R}\theta$, where γ is a constant, A is the area of the suspended coil, B the magnetic field, and K the control constant for the bifilar suspension. Various methods of calibrating the instrument, and of measuring fields, inductances, &c., are given. S. G. S.

1504. *Lines of Force in Various Dielectrics.* **M. Seddig.** (Ann. d. Physik, 11. 4. 815–841, June 22, 1903. Extract of Marburg Dissertation, 1902.)—Take the discharge knobs of an influence machine into a dielectric oil, turpentine preferably, having a powder in suspension. The oil is in a shallow dish so that light can be sent upwards through the dish, and the lines of force along which the powder sets projected on a screen. By such means the author very clearly shows the configuration of the lines of force in various cases: (1) between knobs; (2) between parallel plates; (3) between plates having an oil of greater or less dielectric constant; (4) between plates having a metal ring interposed, and other cases. Sulphate of quinine is generally used for the powder in suspension in the oil. The curves are reproduced photographically in the paper. P. E. S.

1505. *Volume Change in Gases through Dielectric Polarisation.* **R. Gans.** (Ann. d. Physik, 11. 4. pp. 797–814, June 22, 1903. Habilitationsschrift. Physik. Inst. Tübingen, March, 1903.)—The author first discusses the theory of the subject, and finds an expression for the change in volume—

$$\Delta v = -\frac{\epsilon - 1}{2p} \cdot \frac{(\phi_1 - \phi_2)^2}{r_2 - r_1} r_1 r_2,$$

where ϵ is dielectric constant, p is pressure of the gas, ϕ_1 and ϕ_2 are the potentials, and r_1 and r_2 the radii of concentric spheres between which the gas is placed. The change of volume is measured by the movement of a mercury thread in a fine tube. The theoretical conclusion reached is that, after Maxwell's theory, the change in volume is $\left(\frac{\epsilon - 1}{8\pi}\right) E^2$. Drude's modification of the theory would give no change in pressure, all the sources of energy not being provided for by him. Experimentally it is found that the effects are according to theory. Quincke found no change in volume since his manometer was not sensitive enough, and because of the great friction in his narrow capillary tube. P. E. S.

1506. *Electrical Conductivity of Solutions in Sulphocyanates and Mustard Oils.* **L. Kahlenberg.** (Zeitschr. Phys. Chem. 46. pp. 64–69, 1903. Lab. of Physical Chemistry, Univ. of Wisconsin, Madison, July, 1903.)—The following table shows the dielectric constants of the solvents employed:—

	Dielectric Constant.	Temperature.
Methyl sulphocyanate	33·3	15·5°
Ethyl „	31·2	11·5
Amyl „	17·1	19·5
Ethyl mustard-oil	22·0	15·0
Allyl „	17·3	17·6

The values for the first two solvents are approximately the same as for methyl alcohol, and in accordance with the Nernst-Thomson rule the conductivity of ferric chloride is also approximately the same. The conductivity of trichloracetic acid is, however, approximately the same in these solvents as in hydrogen cyanide (dielectric constant 95), and in the case of silver nitrate the conductivity in methyl sulphocyanate is even greater. The conductivity of ferric chloride and trichloracetic acid is greater in ethyl sulphocyanate than in the isomeric mustard-oil. T. M. L.

1507. *Galvano-magnetic and Thermo-magnetic Effects in Antimony and Bismuth.* **G. Barlow.** (Ann. d. Physik, 12. 5. pp. 897–931, Nov., 1903.)—The electronic theory of metals developed by Riecke and Drude requires a relationship between the various phenomena displayed when a metal plate carrying a flow of heat or of electricity is subjected to the action of a magnetic field. The metals chiefly experimented upon are antimony and bismuth, and the related effects are (1) the Hall effect, and (2) the transversal thermo-magnetic effect, (3) the transversal galvano-magnetic effect, and (4) the displacement of the isothermals, (5) the magnetic change of electrical resistance, and (6) the longitudinal thermo-magnetic effect. Some of these separate effects are first measured in antimony at low temperatures, such as the Hall effect, which increases very slowly as the temperature falls. Also, from experiments on bismuth plates, the conclusion is come to that the reversal of the thermo-magnetic effect in this metal is caused by impurities. [See van Aubel, Abstract No. 1142 (1904).] The chief part of the paper deals with the method of causing a simultaneous flow of electricity and heat through the metal so that (1) and (2), (3) and (4), and (5) and (6) respectively balance one another. It is assumed that the Hall and thermo-magnetic effects are additive, so that the total transversal e.m.f. $e = m\beta g + r\beta i$, where m is the thermo-magnetic e.m.f. produced per unit of breadth (β), per unit of temperature gradient (g), and r is the Hall effect per unit of breadth per unit of current density (i). Hence, when the effects neutralise each other, $\frac{m}{r} = -\frac{i}{g}$. The experimental values found for i/g and m give a value of e, which agrees with the observed value to 1 per cent. It is therefore concluded that the transversal e.m.f. in Sb and Bi can be expressed by the above equation where m and r depend only on the magnetic field and the nature of the metal. The paper concludes with an examination of the Hall and thermo-magnetic effects in some other metals. G. E. A.

1508. *Measurement of Electrolytic Resistances of Liquids.* **J. Kowalski** and **B. Zdanowski.** (Acad. Sci. Cracovie, Bull. 10. pp. 793–794, Dec., 1903.) —In the case of high resistances of electrolytes the authors have devised a new method which is a modification of Siemens' condenser method for the measurement of cable resistance. A condenser of capacity C is charged through a resistance R + W, where R is a known ohmic resistance and W the required electrolytic resistance. The time of charging is accurately determined by a Helmholtz pendulum. The condenser is then discharged through a ballistic galvanometer, and the potential (E_t), to which the condenser was charged, is found. If E_0 is the e.m.f. used in charging the condenser the results may be deduced from the formula—

$$R + W = t \log e / C \left\{ \log E_0 - \log (E_0 - E_t) \right\}.$$

This formula is fairly exact if C/K and C_1/C are small, K being the capacity of polarisation of the electrodes and C_1 their electrostatic capacity. The method has been applied to test the validity of Ostwald's law for the case of trichloracetic acid in ethyl alcohol. The authors find that the constant of dissociation $K = 7{\cdot}1 \times 10^{-5}$. A second problem is the investigation of the influence of a non-electrolytic substance on the conductivity of the solution. The law of Arrhenius, $K = K_0 (1 - \frac{A}{2} X)^2$, holds true in the case of trichloracetic acid in mixtures of ethyl alcohol and benzine. E. S. A. R.

1509. *Dielectric Constants of Solvents and Solutions.* **H. E. Eggers.** (Journ. Phys. Chem. 8. pp. 14–36, Jan., 1904. Laboratory of Physical Chemistry, University of Wisconsin, June, 1903.)—In this investigation the author used an apparatus in which the determinations are made by adjusting a system of variable capacity to positions of resonance of electric waves.

He followed closely the method of Drude [Zeits. phys. Chem. 23, 267 (1897)], several liquid sulphur compounds and nitriles being examined. Comparing his results with those of some other observers, he finds that a single cyanogen radicle at the end of a chain greatly raises the dielectric constant, while two cyanogen radicles tend to neutralise each other, the effect being greatest when they are joined as in cyanogen. Hence the value of the constant is largely dependent on the structure of the molecule. As to solutions, the author concludes that Silberstein's formula does not hold, and that the dielectric constant is not a simple function of either constituent. The substances examined were phosphorus and sulphur in carbon bisulphide, menthol and camphor in benzene and carbon bisulphide, and menthol in acetonitrile.

Substance.	Dielectric Constant.	Temperature.
Methyl sulphocyanate	33·3	15·5°
Ethyl sulphocyanate	31·2	11·5
Amyl sulphocyanate	17·1	19·5
Methyl mustard-oil	17·9	40·0
Ethyl mustard-oil	22·0	15·0
Allyl mustard-oil	17·3	17·6
Phenyl mustard-oil	8·5	11·6
Amyl sulph-hydrate	4·9	18·0
Phenyl isocyanate	3·36	17·0
Thiophene	2·85	13·0
Ethyl disulphide	15·6	19·0
Thioacetic acid	17·3	21·0
Acetyl acetone	25·7	18·0
Acetyl methyl hexyl ketone	27·4	19·0
Malonic nitrile	46·3	32·6
Pinacolin	12·6	17·5
Nitro-anisol	23·8	19·8

F. S.

1510. *Dielectric Resistance.* **I. Mościcki.** (Acad. Sci. Cracovie, Bull. 1. pp. 42–45, Jan., 1904.)—The author, with the assistance of K. Kasprowicz, has made a series of experiments on the puncture resistance of high-tension condensers with various thicknesses of dielectrics. For the first series of experiments three kinds of glass (ordinary alkali glass, Schott and Genossen alkali-free 477‴, and thermometer glass 59‴) and ebonite were used, all in the form of tubes silvered outside and filled with mercury. The tubes were placed in insulating oil during the tests. With the first specimen of glass the thickness varied from 0·2 mm. to 2·7 mm., and the rupture pressure varied from 6,400 to 27,150 volts. In the second specimen the thickness varied from 0·2 mm. to 1·24 mm., and the pressure from 6,950 to 18,750 volts. With the third specimen the tube was from 0·19 mm. to 1·2 mm. thick, and the pressure varied from 7,540 to 20,340 volts. With the ebonite tube of thickness 0·2–1·1 mm., the pressure was 4,800–14,600. In all cases the thickness varied directly as the square of the pressure. In a second series of experiments to determine the rupture pressure at the centre of the dielectric, the glass tubes were provided with a thin bulb blown on one end and silvered on its outer surface. With glass of thickness 0·05 mm. to 0·55 mm. a pressure of 6,850–74,960 volts was endured. With ebonite of thickness 0·1 mm. to 0·41 mm. the pressure was 7,864–44,625 volts, showing good proportionality between thickness and pressure. Further experiments with high-frequency alternating currents showed that the rupture pressure with 8,000-9,000 periods is only ⅓ to ¼ that obtained with a frequency of 50 periods per sec. In all cases it was found that the penetrating pressure required was much greater in the centre than at the edge of the dielectric, *e.g.*, glass of 0·5 mm. thickness withstood 11,700 volts at the edge and 67,100 volts at the centre. E. S. A. R.

1511. *Dielectric Constants of some Inorganic Solvents.* **H. Schlundt.** (Journ. Phys. Chem. 8. pp. 122-130, Feb., 1904. Abstract of paper read before Section C of the A.A.A.S., Dec. 31, 1903. Chem. Lab., University of Missouri, Dec., 1903.)—The author has determined the dielectric constants of a number of inorganic solvents by Drude's method. His results are as follows :—

Substance.	Dielectric Constant.	Temperature.	Substance.	Dielectric Constant.	Temperature.
Phosphorus trichloride	3·72	18°	Antimony tribromide	20·9	100°
„ tribromide	3·88	20	„ „ solid	5·05	20
„ tri-iodide	4·12	65	„ tri-iodide	13·9	175
„ „ solid	3·66	20	„ „ solid	9·1	20
Arsenic trichloride	12·6	17	Phosphorus	3·85	45
„ „ solid	3·6	−50	„ liquid	3·85	20
„ tribromide	8·83	35	„ solid	4·1	20
„ „ solid	3·33	20	Silicon tetrachloride	2·40	16
„ tri-iodide	7·0	150	Nitrogen tetroxide	2·56	15
„ „ solid	5·38	18	„ „ solid	2·6	−40

A. F.

1512. *Magnetic Effect of Convection Currents.* **C. Gutton.** (Comptes Rendus, 138. pp. 352-353, Feb. 8, 1904.)—The author has previously described experiments which show that spots of phosphorescent sulphide become brighter when placed in a non-uniform magnetic field. [See Abstracts Nos. 1355 and 1356 (1904).] This increase of brilliancy is visible in even very weak fields, and the sensibility of this method is sufficient to show the magnetic effect of convection currents. A condenser is made with two parallel discs of zinc 16 cm. in diam., placed vertically 1 cm. apart. One of these discs is capable of rotation in its own plane by being mounted on a horizontal spindle, and is kept earthed. The other disc is insulated and connected to one pole of an influence machine, the other pole of which is earthed. The phosphorescent screen is placed in front of the fixed disc, 2½ cm. from the movable one, and is separated from it by an earthed sheet of lead. The following results were observed: When the earthed disc is rotated about 22 times per sec., the brilliancy of the screen is greater when the condenser is charged than when uncharged. When the disc is at rest, charging or discharging the condenser produces no effect. When the condenser remains charged, an increase of brilliancy is observed on rotation and a diminution on stopping. When the condenser is uncharged, rotation or stoppage produces no effect. A current of 1/600,000 of an ampere in a single turn of wire, of 13 cm. diam., placed against the movable disc produced a visible action on the screen. In these experiments the potential difference of the plates of the condenser, as measured by the spark-lengths, was about 30 electrostatic units. This would correspond to a convection current of about 1/280,000 amp.

E. C. R.

1513. *Selenium Cells.* **G. Berndt.** (Phys. Zeitschr. 5. pp. 121-124, March 1, 1904. Phys. Lab. des Technikums, Cöthen, Jan., 1904.)—The author first describes the preparation and construction of selenium cells, using carbon, for the same reasons as Pfund did [see Abstract No. 368 (1904)], as the only substance in contact with the selenium. Two cells were prepared, one of which was cooled immediately after the selenium crystallised, and the other subjected to a temperature of 200° C. for five hours after crystallisation. Both cells behaved in the same manner, and, contrary to Bidwell's theory, both were light-sensitive. To make certain that other chemical action was absent, an iron-constantan couple was placed on the selenium surface, the increase of temperature of the cell being allowed for. No effect was observed. The effect of light of different wave-lengths was tried, using Li, Na, and Tl light, the sensitiveness diminishing with decreasing wave-length. Experiments on the sensitiveness as related to intensity of the light agreed with those of Rosse. Polarisation currents were also observed, which were strengthened by illuminating the cell. With careful and equable treatment the resistance remains steady for months, but the cells are very sensitive to sudden extremes and rough treatment. The author arrives at the conclusion that there are two modifications of selenium, as Marc holds. [See Abstract No. 362 (1904).] L. H. W.

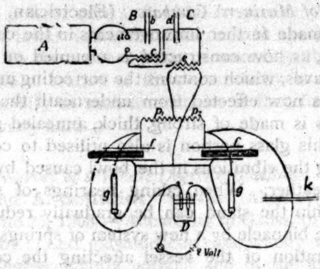
1514. *Temperature Coefficient of Weston Cells.* **H. T. Barnes** and **S. B. Lucas.** (Journ. Phys. Chem. 8. pp. 196–207, March, 1904.)—Having pointed out and discussed the considerable discrepancies that exist between the various determinations of the temperature changes of the e.m.f. of Weston cells, the authors give results of tests made by themselves, which go to show that the variations of the coefficient are chiefly due to the state of the cadmium sulphate solution. They find that cells with solution saturated at 0° undergo practically no change of e.m.f. with temperature; that cells with a saturated solution of constant strength have a coefficient of 0·0030 per cent. per degree; that cells with moist crystals and a 13 per cent. amalgam have a coefficient of 0·0055 per cent., and that cells with moist crystals and a 14·7 per cent. amalgam have a coefficient of 0·008 per cent. per degree.

E. J. W.

1515. *Determination of the Capacity of a Condenser by Successive Discharges.* **H. Morris-Airey** and **E. D. Spencer.** (Manchester Lit. and Phil. Soc., Mem. 48. 11. pp. 1–5, March, 1904.)—This is based on a method of Maxwell's. If Q = quantity, t = time, V = p.d., C = current, R = resistance, and K = capacity, then $K = \frac{Q}{V} = \frac{Ct}{CR} = \frac{t}{R}$. The instrument consists of an electrically-driven tuning-fork with three aluminium-mercury contacts so arranged that the condenser is charged through a galvanometer and discharged automatically 128 times per sec. The galvanometer is shunted until a convenient steady deflection is obtained; a resistance is then substituted for the condenser and contact, and is adjusted to give the same deflection. Tests made at Owens College show very consistent results. H. F. H.

1516. *A Differential Telephone.* **W. Duane** and **C. A. Lory.** (Phys. Rev. 18. pp. 275–279, April, 1904. Paper presented at St. Louis meeting of the A.A.A.S., Dec., 1903.)—The telephone magnet is wound with two coils, and a description is given of means for making the effects of the two on the magnet exactly neutralise one another. One coil is joined in series with the self-inductance to be measured, and the other with a variable standard self-inductance, an adjustable non-inductive resistance being put in the branch of less resistance; the two branches are then connected in parallel and an alternating current sent through them. The authors claim an accuracy of nearly one-hundredth per cent. for this method. E. C. R.

1517. *Use of the Electrolytic Detector in Bridge Measurements.* **W. Nernst** and **F. v. Lerch.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 2. pp. 166–171, May 20, 1904. Göttingen, phys. chem. Institut, March, 1904.)—Nernst has already shown that accurate measurements can be obtained with very high frequencies by putting a small spark-gap or vacuum tube in the bridge (Wied. Ann. 60, p. 600, 1897), but attempts to use a coherer in place of these gave unsatisfactory results. The authors now describe the use of an electrolytic detector in such methods, enabling a telephone to be used as a null instrument. The detector itself, which was made before the authors knew of Schloemilch's cell [see Abstract No. 211B (1904)], consists of two platinum electrodes, one (the anode) being exceedingly small, dipping into caustic potash or dilute sulphuric acid and polarised by about 2 volts. The presence of high-frequency currents was shown by the increased current in the polarised circuit, observed by a telephone or galvanometer. The adaptation of the method to the measurement of dielectric constants is described; these were determined for chloroform, ethyl alcohol, and water, using benzol as standard of comparison, but the figures given are only provisional. The arrangement was as shown in the Fig., where A is a spark coil, B an oscillatory system discharging through the gap *a*; *b* is a capacity (0·005 microfarad), and the self-induction consisted of six turns round a glass beaker, between which turns six other turns, forming the exciting turns of the system C, were wound. An inductive winding *e* supplied the actual bridge, $p_1 = p_2$ (about 15,200 cm., 16 turns on glass 7·5 cm. diam.); *ff* are the measuring condensers with thick glass plates, *gg* compensation vessels, D the detector, and *h* the telephone, *k* being a condenser of about 4 microfarads. B and C were nearly in resonance, the periods being $1{\cdot}7 \times 10^6$ and $1{\cdot}4 \times 10^6$ respectively. The inductive excitation was found to give better minima. As applied to resistance determinations, *gg* are replaced by a tube, filled with Magnanini's solution, provided with an adjustable electrode, and a resistance vessel with platinum electrodes, in which the liquid to be tested is placed. When the latter vessel was adjusted for silence in the telephone with Magnanini's solution, the resistance W_1 was measured by Kohlrausch's method. W_2 is the resistance of the test solution found by Kohlrausch's method, C being the concentration in gm.-mols. With KOH, KCl, and H_2SO_4 solutions the ratio W_1/W_2 gave values differing from the mean by 0·22 to 0·7 per cent., and and at other concentrations by 0·13 to 0·3 per cent. The accuracy with which the null point could be determined was further investigated, and the conclusion arrived at that resistances of from 40 to 1,000 ohms can be determined to within a few tenths per cent., the method being very handy and reliable. L. H. W.



1518. *Thermo-electric Experiments.* **C. Déguisne.** (Elektrotechn. Zeitschr. 25. pp. 423–424, May 26, 1904.)—The author refers to the experimental facts mentioned by Egg-Sieberg, and describes experiments which he carried out in ignorance of Schneider's results. [See Abstract No. 849 (1904).] The experimental results appear somewhat contradictory, though the author explains them as being due to the thermo-e.m.f. between a harder and a softer portion of the same material. One, in particular, carried out to test Schneider's and Egg-Sieberg's assertion as to the e.m.f. due to the temperature gradient, gave negative results. In this, a copper wire was immersed at the two ends in a vessel of water and heated by a gas-flame placed at a distance one-quarter of the space between the two vessels, the temperature gradient being thus twice as steep towards one vessel as towards the other; no e.m.f. between the ends of the wire could, however, be detected with a galvanometer of sensibility of 10^{-7} volt. Similar results were obtained with an iron rod. A number of interesting results are given in the form of a table. Taken altogether, the author considers Egg-Sieberg's theory as yet unproved. L. H. W.

1519. *New Type of Mariners' Compass.* (Electrician, 52. p. 737, Feb. 26, 1904.)—Kelvin has made further improvements in the compass invented by him. The compass, as now constructed, is mounted on a pedestal, strongly built of teakwood staves, which contains the correcting magnets. The illumination of the dial is now effected from underneath the bowl. The underpart of the compass is made of strong, thick, annealed glass through which the light passes. This glass portion is also utilised to contain a viscous oil, effective in damping the vibrations in the bowl caused by the motion of the vessel in stormy weather. When taking bearings of stars or other faint lights, the light within the stand can be gradually reduced. The bowl is suspended inside the binnacle by a new system of springs which are designed to prevent the vibration of the vessel affecting the compass bowl. The helmet of the compass is made conical in shape, and is provided with rifle sights on the top to enable quick bearings to be taken of the sun, lights, buoys, &c. The helmet may be moved freely round in any direction. On the inside are also sights to allow of the bearings being directly read on the dial. In wet or stormy weather the azimuth mirror may be used without the necessity of removing the helmet. W. W. H. G.

ALTERNATING CURRENTS AND MAGNETISM.

1520. *Wave Currents Generated by a Microphone Arrangement.* **R. v. Lieben** and **E. Reisz.** (Elektrotechn. Zeitschr. 24. p. 497, June 25, 1903.)—A description of an arrangement to obtain increased sensitiveness when using a microphone in connection with a telephone. The telephone is connected to the coils of an electromagnet, whose core is placed almost in contact with the iron plate or membrane of the microphone. Thus, if from any cause the current increases, the membrane of the microphone is attracted, and not only has its resistance changed but also reacts upon the electromagnet. In circuit with the microphone a number of different self-inductions are arranged, any one of which can be used at will. By this means tuning is effected within certain limits. E. H. B.

1521. *Magnetic Permeability of Iron Powder for Rapid Oscillations.* **J. Zenneck.** (Ann. d. Physik, 12. 4. pp. 869–874, Oct., 1903. Strassburg, Physikal. Institut.)—The author points out that from the generally given values the permeability of soft iron wires for frequencies of the order of 10^6 per sec. is about 100, and consequently is only 1/10 to 1/30 of the mean value in a stationary field. Braun has, however, shown that at this frequency the permeability of iron powder is practically the same as in a stationary field. [See Abstract No. 1252 (1903).] Experiments are then described in which for the high frequency the author's previous method was employed [see Abstract No. 844 (1904)], and the change of induction caused by the introduction of the iron powder core was measured by a ballistic galvanometer for the stationary field. The iron powder was in the loose form, and also embedded in paraffin wax, and a core of the same total volume used, the powder being the commercial *pulvis Ferri*, containing 92 per cent. Fe. At the high frequency the ratio of the induction with core in, to the induction without core, was, with sparks of 6 to 12 mm. length, about 2·5 in the case of the loose powder and 2·25 with the powder embedded, and remained the same even at 2¼ times this frequency. In the stationary field the values were 2·43 and 2·80 respectively, so that the induction was increased practically to the same extent by the loose powder core at the high frequency, the embedded powder giving a somewhat lower value, the difference in the two cases being 0·55, say 20 per cent. To the value 2·8 for permeability the iron contributes at least 1·8, so that the alteration of the permeability is only $0·55/1·8 = 30$ per cent. The permeability at such frequencies is therefore about 2/3 to 4/5 of its value in a stationary field. L. H. W.

1522. *Magnetic Survey of a Whole Degree of Latitude. Test of Gauss' Theory.* **W. v. Bezold** and **A. Schmidt.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 32. pp. 670–677, June 25, 1903.)—According to Gauss, the terrestrial magnetic field is produced by closed galvanic currents, wholly within the earth, and also, to a small degree, wholly without and in the atmosphere; this field would have a potential. There may, in addition, be a field without potential, produced by currents which cut the earth's surface. If there be only the former field, then (Gauss) the integral $\int S ds$ for a closed curve on the earth's surface should be zero. This zero value has actually been found in certain cases; but when the measurements along whole parallels are computed, considerable discrepancies result. From the material collected by G. v. Neumayer for 1885, A. Schmidt calculates that when l_0 is the mean of the east component Y of horizontal intensity expressed in γ, then—

ϕN	60°	50°	40°	30°	20°	10°	0°	10°	20°	30°	40° S.
l_0	+40	+110	+150	+100	0	−110	−130	−80	−80	−210	−280.

These discrepancies of 4 per cent. might be due to systematic errors, since the stations were very unevenly distributed, and the data concern different years. The authors suggest a survey about the 50° lat. N. This belt offers the longest practical land line across the American Continent, where both the Canadian and the Northern Pacific Railway lines might be followed, and through Southern England, Northern France, and Germany to Russia, and along the Siberian Railway to Vladivostok. H. B.

1523. *Length Change in Ferromagnetics at Various Temperatures.* **K. Honda** and **S. Shimizu.** (College of Science, Tokyo, Journ. 19. 10. pp. 1–

19, 1903.)—Former papers [see Abstracts Nos. 334 and 335 (1903)] show certain results, but here the number of specimens tried is more numerous and varied, and the range of temperature is from —186° C. to 800° C. The measuring and magnetic arrangements are substantially as before. It is interesting to see how the characteristic expansion curves are modified as the magnetic critical temperature is approached. The results are very complete, and great variety of curves are shown. P. E. S.

ELECTROPHYSIOLOGY AND ELECTROTHERAPEUTICS.

1524. *Röntgen Rays in the Diagnosis of Pulmonary Tuberculosis.* **J. F. Halls Dally.** (Archives d'Él. Médicale, 12. pp. 133–138, Feb. 25, 1904. Abstract from the *Lancet*, June 27, 1903.)—Loss of mobility of the diaphragm is probably the earliest indication of tuberculosis of the lung. When the disease has progressed, limitation of diaphragmatic mobility may become more pronounced, but sometimes decreases owing to compensatory hypertrophy of the muscle. Marked limitation may occur even when only the apex of the lung is attacked. This is probably due to toxic influences. In advanced disease, however damaged the base of the lung may become owing to tuberculous infiltration, a clear triangular interval is always left between it and the diaphragm. This corresponds to the lower part of the pleural cavity, which is only occupied by the lung on deep inspiration. H. W. P. Y.

1525. *New Electric Arc Apparatus for Phototherapy.* **T. Marie.** (Archives d'Él. Médicale, 12. pp. 94–107, Feb. 10; pp. 139–148, Feb. 25; pp. 168–173, and Note by **M. Andry,** pp. 173–174, March 10, 1904.)—The apparatus consists of a rectangular brass box 17 cm. high, 7 cm. broad, and 11 cm. deep. The front of the box is provided with a circular opening, over which the rings carrying the quartz compressors are screwed. There are six of these, differing in shape and size to suit the particular part of the face or body to be treated. The carbons are horizontal and at right angles to each other. The negative carbon enters on the right side while the positive enters posteriorly so as to be perpendicular to the plane of the quartz compressor. The arc is enclosed in a second brass box rigidly fixed to the exterior one, and having a circular opening in front closed by a second quartz disc and immediately opposite the first. The water-cooling apparatus is so arranged that the afferent stream of cold water first strikes the inner surface of the compressor and then flows over the front portion of the inner brass box. The lamp, which weighs only 750 gm., is suspended by a chain working over a pulley and provided with a counter-weight, so that it can be raised or lowered to any level. When used for the face, the lamp is fixed in the required position by four elastic cords, which at one end are attached to a firm cushion placed at the back of the head and, at the other, to hooks on the brass box. The tension of the rods can be altered at will. By this means compression is mechanically maintained with the same force throughout the *séance*, without the assistance of the operator or of the patient. The current required to work the lamp is between 10 and 20 amps., with an average of 15 amps.

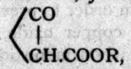
H. W. P. Y.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

1526. *Combustion of Carbon in Reductions by Means of Calcium Carbide.* **Fr. v. Kügelgen.** (Zeitschr. Elektrochem. 9. pp. 411–415, May 14, 1903.)—According to Neumann (Zeitschr. Elektrochem. 8. p. 772, 1902) when metallic oxides are reduced by means of calcium carbide, either in the presence or absence of chlorides of the same metal, the carbon of the carbide is transformed into carbon monoxide. The author has previously expressed the view (Zeitschr. Elektrochem. 8. p. 781, 1902) that carbon dioxide, and not the monoxide, is produced, one molecule of the carbide being able to take 4 atoms of oxygen and giving 5 atoms of the reduced metal, according to the equation $MCl_2 + 4MO + CaC_2 = 5M + CaCl_2 + 2CO_2$, where M represents a diad metal. In support of this view the author now gives the results of a further series of experiments on the action of calcium carbide on oxides, and on mixtures of oxides and chlorides. The experiments were carried out in an atmosphere of nitrogen, in order to prevent oxidation by the air. Only in the case of the reduction of copper oxide, *i.e.*, with a very vigorous reaction, is a certain amount of carbon monoxide produced, about 17 per cent. of CO to 83 per cent. of CO_2. In the case of the reduction of the oxides of zinc, nickel, or lead, or when copper oxide is mixed with sand, only a very small quantity of carbon monoxide, in some cases none at all, is produced. The author therefore assumes that carbon dioxide is the primary product of reaction, and that the monoxide is only produced when an excess of carbide is used and the reaction is very violent, so that the dioxide first produced is reduced by the carbide or by the carbon produced from the carbide. T. S. P.

1527. *Alkali Carbides.* **H. Moissan.** (Elektrochem. Zeitschr. 10. pp. 45–46, June, 1903.)—The author has previously shown that when calcium carbide is made by heating up calcium and pure soot in the electric furnace, it is obtained in the fused condition, the heat of reaction being enough to raise the carbide above its melting-point. If the carbide so produced is heated up to a very high temperature, it becomes dissociated into graphite and metallic vapour. The temperatures of production and dissociation are, however, widely different. In the case of the alkali carbides these temperatures are closer together. If a wire of cæsium or rubidium is embedded in dry soot in a tube free from air, and the temperature gradually raised, it is noticed that combination between the two substances takes place after a time. The moment at which the reaction commences can be told by the soot being projected about the tube. After cooling, small molten masses are found in the midst of the carbon, which, on being thrown into water, give a vigorous evolution of acetylene. The combination between the metal and the carbon is not complete, since the heat of reaction is great enough to dissociate some of the compound. These carbides have also been obtained in another way. The ammonium compounds of cæsium and rubidium were prepared by the action of liquid ammonia on the metals; the compounds so produced give the acetylenic carbides, $C_2Cs_2C_2H_2$ and $C_2Rb_2C_2H_2$, under the action of a stream of acetylene. If these compounds are then heated up in a tube free from air, they are decomposed into acetylene and the carbides. T. S. P.

1528. *Silver Iodide Nitrate and Silver Iodide.* **R. Fanto.** (Akad. Wiss. Wien, Sitz. Ber. 112. 2b. pp. 331–336, May and June, 1903. Chem. Lab. d. Hochschule für Bodenkultur, Wien.)—Zeisel in his methoxyl determinations found that a double compound of silver nitrate and silver iodide was formed. The author has prepared this substance by leading carbon dioxide charged with methyl iodide vapour into alcoholic silver nitrate solution. By leading in the methyl iodide very slowly, fine shiny needles are obtained. Filtered off and dried on a tile, analysis shows the compound to be $AgI, 2AgNO_3$, contaminated with traces of silver iodide. This can be avoided by leading the vapour on to the surface of the alcoholic solution. It is not sensitive to light and melts at 118–119° C., melting at the same point if prepared by fusing together silver iodide and nitrate. The author finds the density of silver iodide to be 5·79 whether prepared from the double compound or by direct precipitation, washing with warm water in both cases. F. S.

1529. *Influence of Unsaturated Radicals on Optical Activity. Ethers of δ-methyl-β-cyclopentanonecarboxylic Acid, α-Allyl or Propyl.* **A. Haller** and **Desfontaines.** (Comptes Rendus, 136. pp. 1613–1616, June 29, 1903.)—The ethers of this acid contain the complex  being thus analogous to campho-carboxylic ester. This is prepared by the condensation of the ester of β-methyladipic acid, which in a 100-mm. tube has $\alpha = 2° 30'$. The ethyl δ-methyl-β-cyclopentanonecarboxylate has $\alpha = +82° 20'$ when of 100-mm. thickness. By treating this in ether with sodium and allyl iodide, the ethyl ester of *α-allyl-δ-methyl-β-cyclopentanonecarboxylic acid* is obtained. This liquid has an aromatic odour and boils at 139–141° at 18 mm. In a 100-mm. tube, $\alpha = +62° 54'$. If sodium alcoholate is used in place of sodium and ether, the ring breaks, and neutral and acid esters of *β-methyl-γ- or α-allyl-γ-methyladipic acid* are formed. The acid crystallises in white needles, melting at 100° and boiling at 235° at 20 mm. In absolute alcohol $[\alpha]_D = 2° 50'$. The ethyl ester of *δ-methyl-α-n-propyl-β-cyclopentanonecarboxylic acid* is formed like the allyl derivative. It is a liquid boiling at 136–137° at 17 mm., and in a 100-mm. tube, $\alpha = +51° 8'$. The effects on the rotation correspond with those observed for allyl and propyl carboxylic acid esters. [See also Abstract No. 898 (1904).] F. S.

1530. *Relative Affinities of Polybasic Acids.* **H. M. Dawson.** (Chem. Soc., Journ. 83. and 84. pp. 725–728, July, 1903.)—The avidity of an acid, as originally defined by Thomsen, and its affinity, based on the theory of electrolytic dissociation, are not always identical. For feeble polybasic acids, the relative affinities for all ordinary concentrations are determined solely by the dissociation of only one of the hydrogen ions, and correct values for their affinities, as measured by their power of combining with bases, are obtained when the quantities of two acids competing for a base stand in the ratio of their molecular and not of their equivalent weights. Values are given for the dissociation of tartaric, malic, succinic and citric acids in 0·25-normal solutions according to the scheme: $RH_2 = RH' + H^{\cdot}$ and also for the dissociation of the anions of the acid salts, according to the equation: $RH' = R'' + H^{\cdot}$. The second dissociation is found to amount to only 1 per cent. of the first. If the free acids were taken instead of the acid salts, the second dissociation would, owing to the presence of hydrogen ions from the first, be still smaller and may hence be entirely neglected. In the case of strong polybasic acids, the affinity is a complex factor determined by more than a dissociation phenomenon. In determining, for instance, the distribution of a base between two acids, it is necessary to remember that the dissociation of such an acid as sulphuric acid only partially proceeds according to the simple scheme: $H_2SO_4 = SO_4'' + 2H^{\cdot}$. T. H. P.

1531. *Gases Occluded by Radium Bromide.* **W. Ramsay** and **F. Soddy.** (Nature, 68. p. 246, July 16, 1903.)—The gases evolved from 20 mgm. of radium bromide, which had been kept for a long time in the solid state, were examined. After the hydrogen and oxygen were removed the spectroscope showed the presence of carbon dioxide. After freezing out this gas together with the emanation, the residue gave the D_3 line of helium. This was repeated with a further quantity of the radium salt, when the spectrum was found to be that of pure helium with two new lines. From Rutherford's work upon the mass of the "α-rays," the authors consider that their results prove that these "rays" consist of helium. [See also Abstract No. 791 1904).] E. C. C. B.

1532. *Determination of the Electrochemical Equivalent of Silver.* **G. van Dijk** and **J. Kunst.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 441–449, Jan. 21, 1904. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, Dec. 19, 1903. Physical Lab., University of Groningen.)—As the laboratory in which the authors worked had been built without iron and was free from the effects of vibrations and stray currents, a tangent galvanometer was employed, as its constant can be accurately determined. The value of H and its time-variations were determined by a bifilar magnetometer (F. Kohlrausch, Wied. Ann. 17. 737, 1882) in conjunction with a local variometer (Kohlrausch). Two different tangent galvanometers were employed. The voltameters contained platinum kathodes (cup-shaped or cylindro-hemispherical) and silver anodes (silver rods). The electrolyte was a 20 per cent. neutral $AgNO_3$ solution (from E. Merck or J. W. Giltay, Deeft). Any particles falling from the anode were intercepted by a parchment sheath. Two voltameters were always used in series, and agreed very closely. Time was measured by a chronometer ticking half-seconds, which was compared every day against an accurate astronomical clock. As a result of 24 determinations the value found is 0·0111818 ± 0·0000004 (mean error). The authors believe this number is accurate to one part in 10,000.

Previous determinations :—

Mascart	0·011156	1884
F. and W. Kohlrausch	0·011183	1884
Rayleigh and Mrs. Sidgwick	0·011179	1884
Pellat and Potier	0·011192	1890
Kahle	0·011183	1898
Patterson and Guthe	0·011192	1898
Pellat and Leduc	0·011195	1903

(The authors omit to mention the important work of Richards). F. G. D.

1533. *Diffusion of Liquids.* **S. Nakamura.** (College of Science, Tokyo, Journ. 19. Art. 8. pp. 1–21, 1903. Physical Institute, Imp. Univ., Tokyo.)—

Experiments on the diffusion of NaCl and $ZnSO_4$ in water. The diffusion took place in a rectangular vertical vessel and was followed by an optical method. One of the vertical sides of the diffusion vessel was formed by the surface of a prism. Light entering by one of the other surfaces of the prism was reflected from the solution and emerged from the third face. The angle made by the critical emergent ray with the normal to this face was determined by a cathetometer, and from this the index of refraction, and hence the concentration of the solution, at that particular horizontal plane could be deduced. The results confirm Fick's law and show that k, the diffusion constant, is independent of the concentration. F. G. D.

1534. *A Reaction, the Rate of which is Diminished by Rise of Temperature.* **Miss C. C. Benson.** (Journ. Phys. Chem. 8. pp. 116–121, Feb., 1904.)—The author finds that the liberation of iodine from solutions containing chromic acid, potassium iodide, and ferrous sulphate, proceeds at a less rate at 30° than at 0°, but otherwise follows much the same course at the higher temperature as at the lower. At both temperatures the rate is proportional to the first power of the concentration of the iodide and of the ferrous salt, and to the 1·7th power of the concentration of the bichromate. The author has not time to conduct experiments which may test different suggested explanations of the above results, but points out that the only known reactions with negative temperature coefficients are those in which colloidal catalytic agents are involved. [See also Abstract No. 1214 (1904).] D. H. J.

1535. *Determination of the Reaction of a Liquid with the Aid of Indicators.* **H. Friedenthal.** (Zeitschr. Elektrochem. 10. pp. 113–119, Feb. 19, 1904.)—The author communicates the results of a valuable study of the employment of a large number of different indicators for the determination of the concentration of hydrion or hydroxidion. The colours given by different indicators according to the concentration of the hydrion and hydroxidion, are collected together in tabular form. The preparation of solutions of definite hydrion concentration by means of mixtures of Na_2HPO_4 and NaH_2PO_4 is given. A. F.

1536. *Electrochemical Determination of the Solubility of Glass.* **F. Haber** and **H. Schwenke.** (Zeitschr. Elektrochem. 10. pp. 143–156, Feb. 26, 1904. From the Chem.-techn. Institut d. techn. Hochschule, Karlsruhe.)—The authors discuss the various chemical and physico-chemical methods for testing glass and the mechanism of the action between glass and water, and give the following rapid method for the technical examination of glass bottles. The bottle is carefully washed, filled with "conductivity" water, and heated to 80° for five hours. Two small platinum electrodes, fused into good glass, are introduced, and a steady stream of air free from carbon dioxide passed through the water. The conductivity of the water is measured every hour by means of a direct-current; the strengths of current, corresponding with voltages of 30, 20, and 10, are measured by an ammeter and the resistance calculated graphically. It is found that the conductivity of the water (less the initial conductivity), divided by the time of action, gives a fairly constant, characteristic magnitude for a particular kind of glass—its rate of solution. Some of the glasses investigated (brown and green wine-bottles) are attacked to a scarcely greater extent than Jena glass. The rate at which the air is passed in to stir the water is without influence on the rate at which the glass is attacked, but renewal of the water diminishes this rate considerably. The auto-catalytic character of the reaction is apparently not in agreement with its proportionality to the time. Probably at first alkali is dissolved and later and more slowly, silica. That alkali alone is not dissolved is seen from the relation between the amount of dissolved matter and the increase of conductivity. T. H. P.

1537. *Enzyme Actions considered as Equilibria in a Homogeneous System.* **A. W. Visser.** (Konink. Akad. Wetensch. Amsterdam, Versl. 12. pp. 605–609, March 23, 1904. Translated from Versl. van de gewone vergadering der Wis- en Natuurkundige Afdeeling, Feb. 27, 1904.)—The author discusses the experiments of Croft Hill, Kastle, and Loewenhart (Amer. Chem. Journ. 26. 533), Hanriot (Comptes Rendus, 132. 212), Emmerling (Ber. d. d. Chem. Ges. 34. 3810), E. Fischer and E. F. Armstrong (ibid. 35. 3151), and some experiments of his own on invertase and on emulsin. The results point clearly to the establishment of definite equilibria. Reference is also made to the dynamical researches of O'Sullivan and Tompson, Tammann, Duclaux, Henri, and Herzog, and to a forthcoming paper in which the author has developed the kinetics of enzyme action on new lines. The paper concludes with a summary of results, the chief of which are as follows: (1) A change of temperature from 0° to 25° scarcely affects the equilibrium-point of the saccharose inversion, which agrees with the small calorific effect of the reaction. (2) At a definite temperature the enzyme only affects the velocity of the reaction, not the position of the equilibrium-point. (3) The velocity is proportional to the enzyme concentration. (4) The intensity of the action of invertase is dependent not only on the relative amount of invert sugar but also on that of saccharose present. [See also Journ. Chem. Soc. 78. p. 634 and 83. p. 578.] F. G. D.

1538. *On the Reactivity of the Alkyl Iodides.* **F. G. Donnan.** (Roy. Dublin Soc., Proc. 10. 21. pp. 195–202, March 30, 1904.)—The author gives a short summary of experiments on the relative reactivities of the alkyl iodides as measured by interaction with silver nitrate. The relative velocities in methyl and ethyl alcohols are as follows:—

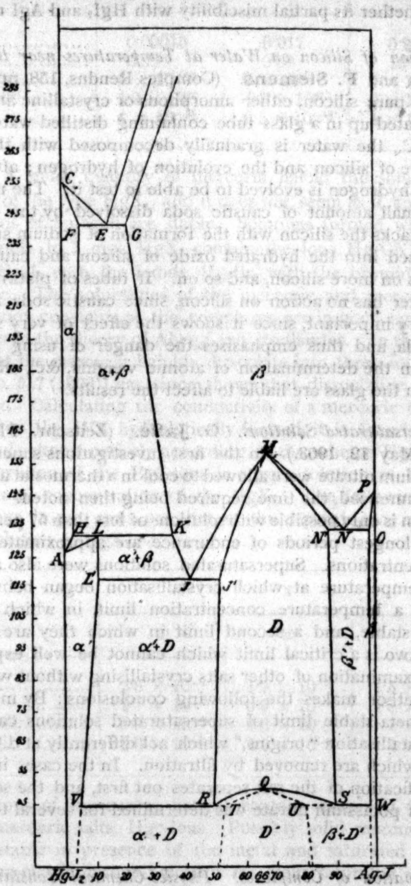
	$k_{\mathrm{EtOH}} \times 10^5$	$k_{\mathrm{MeOH}} \times 10^5$	$k_{\mathrm{MeOH}}/k_{\mathrm{EtOH}}$
Methyl iodide	93·5	180	1·92
Ethyl iodide	220·0	442	2·00
n-propyl iodide	98·4	226	2·29
n-butyl iodide	68·6	145	2·11
Isobutyl iodide	13·8	—	—
Isoamyl iodide	56·5	—	—

The reactivity is about twice as great in methyl as in ethyl alcohol solution. As compared with other reactions of the iodides, the abnormally low reactivity of methyl, as also of isobutyl, iodide with silver nitrate is pointed out, but the question of whether this is due to dissociation, as suggested by Nef, is left open. The alkyl iodides turn brown when exposed to light, and the author found that there is a general parallelism between the velocity with which this change takes place and the reactivity with silver nitrate; methyl iodide, however, behaves exceptionally. A. F.

1539. *Velocity of Crystallisation of Isomorphous Mixtures.* **M. Padoa.** (Accad. Lincei, Atti, 13. pp. 329–337, April 10, 1904.)—The addition of stilbene or benzilidene-aniline to azobenzene, cinnamic acid to phenylpropionic acid, and other substances which produce solid solutions, is found to cause at the most only a very slight diminution in the velocity of crystallisation of the original substance, and the author concludes that such mixtures do not obey the law formulated by Pickardt [see Abstract No. 850 (1903)] that equimolecular quantities of different substances produce the same diminution in the velocity of crystallisation, so that his method for determining molecular weights is not applicable to such cases. Conversely, when no very distinct lowering of the velocity of crystallisation of a substance is produced by addition of another body, the formation of a solid solution may be inferred. With polymorphous bodies the velocity throws some light on the formation of isomorphous mixtures in various crystalline modifications. The author confirms Tammann's conclusions that the addition of different substances to a solution may sometimes favour and sometimes inhibit the formation of nuclei, while the addition of isomorphous bodies has no effect on their formation. W. H. Si.

1540. *Influence of Hydriodic Acid on the Oxidation of Sulphurous Acid.* **A. Berg.** (Comptes Rendus, 138. pp. 907–909, April 11, 1904.)—The author has studied the oxidation of sulphurous acid with and without addition of hydriodic acid, and he finds that the latter, according to its amount, retards or accelerates the oxidation of the sulphurous acid. For each solution of the latter there appears to exist a certain concentration of hydriodic acid which is without influence on the oxidation. In the case of 4 per cent. solutions this concentration is about 3 per cent., corresponding to 1 gm. mol. of hydriodic acid and 3 gm. mols. of sulphurous acid. Hydriodic acid is not the only substance capable of accelerating the oxidation of sulphurous acid. Manganese and ferrous chlorides act in the same way, as also the soluble metallic iodides. Potassium chloride and bromide, however, are without influence. Hydrochloric acid retards the oxidation, and, when present in large amount, may entirely inhibit it. A. F.

1541. *Mixed Crystals of Mercuric Iodide and Silver Iodide.* **A. Steger.** (Zeitschr. Phys. Chem. 43. pp. 595–628, May 12, 1903.)—The author has made a full study of the conditions of formation and transformation of mixed crystals of mercuric iodide and silver iodide [*cf.* Roozeboom, Abstract No. 678 (1900)]. The results which he has obtained may be summarised as follows, the graphic representation of the equilibria being given in the accompanying figure: All melts containing mercuric iodide and silver iodide yield mixed crystals on solidifying. From 0–5 per cent. of AgI a continuous series of mixed crystals of the α type of HgI_2, and from 20–100 per cent. of AgI, a continuous series of mixed crystals of the type β of regular AgI. The mixtures of intermediate composition solidify below 242° to a conglomerate of α (5 per cent. AgI) and β (20 per cent. AgI) mixed crystals (points F and G). As the temperature falls the boundary curves of region of separation into two mixed crystals become wider apart, so that at 132° the limits are 2 and 35 per cent. AgI (points H and K). Rhombic HgI_2 changes into tetragonal form (α type) at 127° (point A). Addition of AgI raises their transition-point to 132° (point L). At this temperature all mixtures lying between 2 and 35 per cent. AgI undergo transformation, the α-crystals giving place to α'-crystals, which, however, contain 10 per cent. AgI. Below 132° there is therefore a "field" for $\alpha' + \beta$ mixed crystals. This area extends downwards to 118°, at which temperature the β-mixed crystals contain 40 per cent. AgI (point J). The regular AgI changes into the hexagonal form (type β′) at 147° (point P). Addition of HgI_2 lowers this temperature to 135°, when the mixture contains 90 per cent. AgI. In this transformation β′-mixed crystals are formed containing only



very little HgI_2 (curve PO). In the β-mixed crystals containing between 40 and 90 per cent. of AgI a transformation occurs which exhibits a point of maximum temperature at 158°, with a composition of 66 per cent. AgI (point M). It is probable that here a transformation takes place of the β-mixed crystals into the compound $HgI_2.2AgI$, the area for the existence of which is represented by D. The temperature of formation of the compound is lowered both by the addition of AgI and of HgI_2. In the former case to 135° (point N′), and in the latter to 118° (point J′), the mixture containing in the former case 90, and in the latter case 40 per cent. AgI. As the temperature is lowered the three series of α'-, p'-, and D-mixed crystals continue to exist down to 50–45°, where the double salt undergoes a change. It is, however, not known whether its partial miscibility with HgI_2 and AgI remains. A. F.

1542. *Action of Silicon on Water at Temperatures near the Boiling-point.* **H. Moissan** and **F. Siemens.** (Comptes Rendus, 138. pp. 939–941, April 18, 1904.)—If pure silicon, either amorphous or crystalline and in a very fine powder, is heated up in a glass tube containing distilled water at a temperature of 95° C., the water is gradually decomposed with the formation of hydrated oxide of silicon and the evolution of hydrogen; after six to twelve hours enough hydrogen is evolved to be able to test it. The reaction is really due to the small amount of caustic soda dissolved by the water from the glass; this attacks the silicon with the formation of sodium silicate, which is then hydrolysed into the hydrated oxide of silicon and caustic soda. The soda then acts on more silicon, and so on. If tubes of platinum or silica are used pure water has no action on silicon, since caustic soda is absent. The reaction is very important, since it shows the effect of very small quantities of caustic soda, and thus emphasises the danger of using glass vessels in experiments on the determination of atomic weights, &c., where substances dissolved from the glass are liable to affect the results. T. S. P.

1543. *Supersaturated Solutions.* **G. Jaffé.** (Zeitschr. Phys. Chem. 43. pp. 565–594, May 12, 1903.)—In the first investigations supersaturated solutions of potassium nitrate were allowed to cool in a thermostat at 20° C. till crystallisation commenced, the time required being then noted. It is found that supersaturation is only possible with solutions of less than 57 per cent. strength, also that the longest periods of endurance are approximately the same at different concentrations. Supersaturated solutions were also allowed to cool slowly, the temperature at which crystallisation began being noted. The author found a temperature concentration limit, in which supersaturated solutions are stable, and a second limit in which they are always labile; between the two is a critical limit which cannot be well explained. From this, and the examination of other salts crystallising without water of crystallisation, the author makes the following conclusions: By mechanical purification the meta-stable limit of supersaturated solutions can be widened. There are crystallisation "origins," which act differently at different concentrations, and which are removed by filtration. In the cases investigated the unstable modification of the salt separates out first, and the solubility of this modification of potassium nitrate was determined for several temperatures. F. S.

1544. *Formation of Complexes. Physico-Chemical Constants of Mercury Haloids.* **M. S. Sherrill.** (Zeitschr. Phys. Chem. 43. pp. 705–740, May 22, 1903; and 47. pp. 103–106, Jan., 1904. Zeitschr. Elektrochem. 9. pp. 549–554, July 2, 1903. Physik-chem. Abteilung des Chem. Universitätslaboratoriums, Breslau.)—The author's investigations, made with a view to explaining the nature of the compounds existing in solutions of mercury haloids in presence of alkali haloids, give the results shown in the following table, in which (1) represents the solubility, in gm.-mols. per litre, of the mercuric haloids in water at 25°, (2) their distribution coefficients in water : benzene, (3) the solubility of the mercurous haloids, (4) the constants expressing the stability of the complex HgX_4, and (5) the dissociation constants of the mercuric haloids :—

	X = CN	I	Br	Cl
(1)	0·44	0·00013	0·017	0·263
(2)	—	0·026	0·89	13·4
(3)	—	3×10^{-10}	7×10^{-8}	1×10^{-6}
(4)	$2·5 \times 10^{41}$	$1·9 \times 10^{30}$	$4·3 \times 10^{21}$	9×10^{15}
(5)	—	4×10^{-25}	$6·5 \times 10^{-18}$	1×10^{-14}

In presence of a small quantity of mercuric haloid the solutions contain principally ions of the type HgX_4'', and it does not seem as if complexes with larger proportions of halogen are stable. Solutions formed with less alkali haloid than 2 mols. to 1 mol. HgX_2 contain the ions $Hg(CN)_3'$ in the case of the cyanide, Hg_2I_7'' with the iodide, Hg_2Br_6'' with the bromide, and Hg_3Cl_8 with the chloride. The solubilities of the mercuric and mercurous haloids and the dissociation constants of the complexes are in good agreement with the requirements of the theory of Abegg and Bodländer. In the above work it is assumed that the mercuric haloids dissociate into three ions, but Morse [see Abstract No. 517 (1903)] has since shown that dissociation into two ions is much stronger. Calculating the conductivity of a mercuric chloride solution as due only to the HCl hydrolytically formed, it is found that the dissociation proceeds almost entirely according to the scheme $HgCl^{\cdot} + Cl'$, and that the concentration of the Hg''-ions in a pure solution of HgX_2 is independent of the total concentration of the HgX_2. The following table gives the concentrations, in gm. mols. per litre, of the separate ions and molecules in a saturated solution of HgX_2 :—

	X		
	Cl	Br	I
HgX_2	$2·6 \times 10^{-1}$	$1·7 \times 10^{-2}$	$1·3 \times 10^{-4}$
$HgX^{\cdot} = X'$	$2·7 \times 10^{-4}$	$0·9 \times 10^{-5}$	$1·8 \times 10^{-8}$
$Hg^{\cdot\cdot}$	$3·5 \times 10^{-8}$	$0·9 \times 10^{-9}$	1×10^{-13}
HgX_4''	$1·6 \times 10^{-6}$	$2·8 \times 10^{-8}$	2×10^{-14}

Saturated solutions of mercurous haloids contain more Hg_2''-ions than the corresponding mercuric salts, $Hg^{\cdot\cdot}$-ions. Possibly solid mercurous and mercuric salts are stable in presence of the metal and saturated solutions. A saturated solution of mercurous haloid is far from saturated with mercuric haloid. The author shows in various ways that the different solutions saturated with mercurous haloid represent approximately equivalent solutions of the corresponding mercuric haloids of the concentration 3×10^{-6} normal.

T. H. P.

1545. *Precipitate-Membranes and Cells in Jellies or Solutions of Glue, Albumen, and Starch.* **G. Quincke.** (Ann. d. Physik, 11. 3. pp. 449–488, June 4, 1903.)—The results of the author's experiments may be summarised as follows: On mixing aqueous solutions of alkali bichromate and silver nitrate in presence of α- or β-glue, a brown, oily liquid (silver-chromate glue) A is obtained, which exhibits surface tension towards the surrounding aqueous liquid B; this tension is less with concentrated than with dilute glue solutions. Under the influence of the surface tension, silver chromate-glue forms in β-glue solutions of varying concentration, either bubbles, cohering froth-chambers, tubes with swellings and peculiar branched cells, or a homogeneous pasty liquid. When alkali bichromate (or silver nitrate) solution penetrates a narrow glass tube containing gelatinised glue charged with silver nitrate (or alkali bichromate), brown transverse walls bounded by spherical or spiral surfaces are formed. These gradually break down into balls from which singly-refracting, regular crystals are deposited. A similar phenomenon is observed with sodium chloride or potassium bromide and gelatinised glue containing silver nitrate, and with alkali bichromate or potassium ferrocyanide and gelatinised glue charged with copper sulphate or ferric chloride. On passing a 1 per cent. ferric chloride or hydrochloric acid solution through a syphon tube of 0·5 mm. diameter into an aqueous β-albumin solution for a few seconds, a tube of oily liquid, 30–80 mm. long and 4 mm. diam., with swellings and a round top, quickly forms. Water diffuses from the outside into the tube, which becomes swollen; the thinner the wall of the tube and the more dilute the ferric chloride or hydrochloric acid solution the more rapid is this diffusion. [See also Abstracts Nos. 909 and 1574 (1902) and 476 (1904).] T. H. P.

1546. *Dependence of the Index of Refraction of Salt Solutions on the Concentration.* **J. Wallot.** (Ann. d. Physik, 11. 3. pp. 593–604, June 4, 1903. From the Münchener Inaugural Dissertation.)—The author has used the determinations of different investigators to ascertain in how far the constants of the empirical interpolation formulæ possess a physical meaning, and also the interpolation formulæ to which the laws of mixtures lead. A modification of Landolt's formula $\frac{n_s - \nu}{\nu - n_w} = \frac{D}{p}$ was found to give very good results: n_s = index of refraction of solid salt, n_w = index of refraction of solvent, $\nu = 1 + (n - 1)(1 - c)$, c being a function of the concentration. Further, D is the density and p = amount of salt in 100 parts of solvent. A. F.

1547. *Mercuric Chloride and Water.* **D. Strömholm.** (Zeitschr. Phys. Chem. 44. pp. 63–73, June 9, 1903. Universitätslaboratorium, Upsala.)—Known amounts of anhydrous ether and water were mixed and then varying proportions of anhydrous ether added. The solubility of mercuric chloride in these was determined by shaking up the solvent with mercuric chloride or its double salts. The increase of water present raises the saturation concentration. But the rate of increase of saturation over increase of water present varies with different double salts. Assuming that a compound $HgCl_2, H_2O$ is formed, then the ratio of the mercuric chloride not united with water to the whole amount present is fairly approximately constant. Probably more complex hydrates are formed, but the figures obtained gave no means of identifying them. Some further explanations of the author's work on the double salts of mercuric chloride are given (Journ. f. prakt. Chemie, 66. p. 442). F. S.

1548. *Colloidal Silver.* **Hanriot.** (Comptes Rendus, 136. pp. 1448–1449, June 15, 1903.)—Commercial collargol, which is really silver lysalbinate, was purified by precipitation with dilute acetic acid and redissolving in ammonia. After this had been repeated four times, the proportion between silver and nitrogen became constant, viz., Ag 93·1 per cent., N 0·88 per cent. By heating 1 gm. in a mercurial vacuum, 9·8 c.cm. CO_2 and 8·2 c.cm. H were obtained, the ratio between Ag and H being about $Ag_{12}H$. Colloidal silver was then prepared by Carey Lea's method, but even after repeated purification it only contained 89·3 per cent. Ag. This substance is different from collargol and is more unstable. On distillation in a vacuum, figures were obtained giving the ratio $Ag_{12}H$. The author concludes that these and analogous bodies are complex hydrogen derivatives of silver. [See also Abstract No. 1550 (1904).]

F. S.

1549. *Oxidation of Manganese Salts by Alkaline Persulphates in Acid Solution.* **H. Baubigny.** (Comptes Rendus, 136. pp. 1662–1664, June 29, 1903.)—In order to find out why the quantity of manganese remaining dissolved after the action of the persulphate, increases with the acidity of the solution, the author has studied the action of potassium permanganate on an acid solution of manganese sulphate. He finds that the reaction depends—(1) on the acidity of the solution; (2) on the concentration of the manganese salt as well as on that of the permanganate; (3) on the temperature. Thus on the addition of 0·040 gm. potassium permanganate to 2 litres of a solution containing 100 c.cm. of concentrated sulphuric acid and 0·5 gm. of manganese sulphate no precipitate is formed after standing for 48 hours. A precipitate is formed after a short time, however, if the solution is heated, or if the quantity of permanganate is increased to 0·150 gm. In all cases, whether a precipitate is produced or not, the manganous salt is oxidised to the manganic state. If a precipitate is formed, it always consists of manganese dioxide. In hot solutions the phenomena observed are the same, except that the reactions take place more quickly, and the decomposition of the manganic salt takes place to a greater extent, since the stability of the salt in aqueous solutions of the same acidity decreases with rise in temperature. The persulphate, therefore, transforms the manganous salt at first into the manganic state, either directly, or by the secondary action of the permanganic acid, which is first formed, on the excess of manganous salt. The manganic salt then decomposes with the precipitation of manganese dioxide. In the presence of a sufficient quantity of persulphate the transformation of the manganous salt is complete. The more acid the solution is, the greater is the quantity of manganic salt which remains in solution, since the stability of the manganic salt in aqueous solutions increases with the acidity of the solution. A colouration of the filtrate from the manganese dioxide precipitate, due to the presence of manganic salt, is only to be observed when the acidity is greater than 3 per cent. (volume per cent.) of sulphuric acid. The author has also observed that 1 gm. of potassium permanganate dissolves in 18·06 gm. of water at 16° C. The density of the saturated solution at 16° C. is 1·0362 and contains 0·0542 gm. of the salt per c.cm.

T. S. P.

1550. *Colloidal Silver.* **A. Chassevant** and **S. Posternak.** (Chem. News, 8. pp. 38–39, July 24, 1903. Bull. Soc. Chim., series 3, vol. 29, No. 11.)—Colloidal silver has been prepared by the authors in the form of a greyish powder containing 90·08 per cent. of silver and differing from the commercial product (collargol) in not containing any albuminoid matter. The method of preparation was similar to that adopted by Carey Lea for citrate of iron.

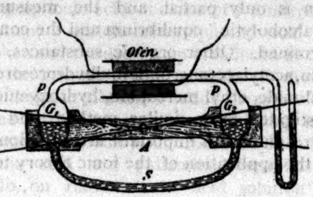
The product is regarded by the authors as a colloid without definite chemical functions; it cannot be considered as an acid—collargolic acid, according to Hanriot's suggestion—on account of its solubility in ammonia and alkalis any more than it can be looked on as a base because of its solubility in acetic acid. If the solution of colloidal silver in ammonia contained ammonium collargolate, as Hanriot suggests [see Abstract No. 1548 (1904)], it would be difficult to explain the authors' observation that ammonium carbonate precipitates colloidal silver from ammonia solutions. The passage of an electric current through colloidal solutions of silver causes a transference of silver to the *anode* in the case of alkaline solutions, and to the *kathode* in the case of acid solutions; in each case there is a deposit of ordinary solid colloidal silver on the electrode. The difference is not to be ascribed to any chemical property of the colloid, but to the differences in the electrostatic charges communicated to the particles by the most mobile ions present in the solutions. D. H. J.

1551. *Rime-Curves* (Reifcurven). **W. Meyerhoffer.** (Zeitschr. Phys. Chem. 46. pp. 379–398, 1903. Berlin-Wilmersdorf, Aug., 1903.)—A discussion of the well-known facts relating to the phase-theory of mixtures of salts, double salts, and isomorphous mixtures by means of a new species of diagrammatic representation, which is virtually an extension to systems containing only gaseous and solid phases of the *ligne de rosée* of Duhem. The rime-curves, in fact, represent the pressure of a gaseous phase, in equilibrium at constant temperature with solid phases, as a function of the composition of the vapour. This method of representation appears well adapted to a clear exposition of the complex facts of isomorphism. F. G. D.

1552. *Constitution of Salt Solutions.* **St. Labendzinski.** (Zeitschr. Elektrochem. 10. pp. 77–81, Jan. 29, 1904.)—This is an abstract of an investigation by the author, communicated by R. Abegg. Measurements of the p.d.'s between electrodes of Pb, Cu, Cd, Co, Zn, Fe, and aqueous solutions of varying concentration of the corresponding nitrates, chlorides, sulphates, and acetates. In some cases—all the salts of Ni and the nitrates of Zn, Cd, Fe, and Co—the p.d.'s could not be directly measured. This difficulty was surmounted by employing Luther's electrodes (of the "third sort"). The results show that there is complex-formation in all the above solutions. This complex formation increases with the strength of the solution and with the addition of soluble salts possessing a common anion. It is therefore chiefly a formation of complex anions. This formation of complex ions increases in the order, nitrate, chloride, sulphate, acetate. The non-validity of Ostwald's dilution-law for such solutions receives a qualitative explanation in these results. The paper concludes with a calculation of the ionic solubility-products for the hydroxides of lead, zinc, nickel, cobalt, and cadmium, as determined by p.d. measurements with Luther electrodes. F. G. D.

1553. *Application of Physical Chemistry to Serum Therapy.* **S. Arrhenius.** (Zeitschr. Elektrochem. 10. pp. 111–112, Feb. 19, 1904. Report read before the Kaiserl. Gesundheitsamt, Berlin, Dec. 22, 1903.)—In this paper the author indicates how the methods of physical chemistry can be applied to the study of toxins and antitoxins. In collaboration with Madsen, the author has found that the rendering a toxin innocuous by means of its antitoxin is analogous to the neutralisation of an acid by a base, and that the process is subject to the law of mass action. Tetanolysin and antilysin combine until a condition of equilibrium is established, just as, *e.g.*, ammonia and boric acid. The relationships in the case of the hæmolysins are only slightly more complicated. The hæmolysins consist of a portion comparatively stable to heat, the amboceptor, and of a portion destroyed by a temperature of 60°, complement. Hæmolysin itself is in equilibrium with these two substances, so that there is the equilibrium (amboceptor) × (complement) = K × (hæmolysin). The action of hæmolysin is reduced by the so-called anti-complement, also in accordance with the law of mass action. Attention is also drawn to the catalytic action of antitoxins. A. F.

1554. *Equilibrium between Iron, Ferrosoferric Oxide, Hydrogen, and Water Vapour.* **G. Preuner.** (Zeitschr. Phys. Chem. 47. pp. 385–417, March 15, 1904. Read as Habilitationsschrift v. d. philosoph. Fakultät d. Universität, Kiel.)—The equilibrium between iron, ferrosoferric oxide, hydrogen, and water vapour was first studied by Deville, but the values obtained for the ratio p_{H_2O}/p_{H_2} were not constant, at constant temperature, as is demanded by the law of mass action. The author has therefore reinvestigated the equilibrium in the above system, taking especial precautions to avoid one source of error in the experiments of Deville, viz., the long diffusion space which hindered the production of the true equilibrium. The author employed a much shorter heating tube and avoided the source of error due to slow diffusion, by keeping the gas mixture in motion. The principle of the apparatus is shown in the accompanying Fig. The tube *pp* is the reaction tube, which was heated by means of an electrical current, the temperature being determined by means of a thermo-electric couple. The tube *pp* is connected with a manometer and also with two vessels G_1 and G_2 containing water, and joined together by means of the tube S. The whole is mounted on a frame A, pivoted at its centre. By giving this a rocking motion, the tube *pp* is alternately filled with the vapour from G_1 and G_2. The whole apparatus was immersed in a large water-bath at constant temperature. By this means very concordant figures were obtained. The equilibrium was determined at three temperatures, 900°, 1025–1050°, and 1150°. The mean values for p_{H_2O}/p_{H_2} at these three temperatures are 0·69, 0·78, and 0·86. The heat effect of the reaction $3Fe + 4H_2O = Fe_3O_4 + 4H_2$ was calculated from these figures according to van't Hoff's formula and gave the values 11,900 cals. between 900° and 1025° and 11,490 between 1025° and 1150°. A. F.



1555. *Applications of Physical to Organic Chemistry.* **R. Abegg.** (Zeitschr. Elektrochem. 10. pp. 185–189, March 18, 1904.)—A discussion of C. Tubandt's dissertation (Halle, 1904) on the action of acidic and basic substances in increasing the speed of inversion of L-menthon, and of J. Walker's paper on the theory of amphoteric electrolytes. [See Abstract No. 1574 (1904).] Vorländer has shown that under the action of catalytic agents L-menthon is converted into a dextro-rotatory equilibrium-mixture of L- and R-menthon. The velocity of this "inversion" can be polarimetrically determined. The subject has been further investigated by Tubandt (working under Vorländer), and a number of interesting and important results obtained. Menthon possesses an optical rotatory power proportional to its concentration, the composition of the equilibrium-mixture is independent of the amount of catalyst present, and the velocity of the inversion is unaffected by the presence of neutral substances such as sodium acetate, sodium bromide, various esters. When to these advantages is added the further one that menthon is soluble in most organic solvents, it will be seen that this substance is likely to become a powerful weapon in the hands of the physical chemist. Sodium ethylate in absolute alcoholic solution was found to increase the velocity of inversion proportionately to its concentration in stronger solutions, and rather more rapidly in weaker solutions. Amines had only a slight action, quaternary bases a powerful one. Strong acids acted much more powerfully than strong bases. Weak acids, such as H_2S, HCN, $CH_3 . COOH$, phenols, aceto-acetic ester, and malonic ester were almost without action. The acid character of such substances as the two last-mentioned esters was established, however, by their effect on the inverting power of sodium ethylate, this effect being due to salt-formation with the consequent diminution of the active C_2H_5O ions. This salt-formation is only partial, and the measurements enabled the character of this "alcoholytic" equilibrium and the constants of the "alcoholysis" to be determined. Other organic substances, such as cyano-acetic ester, desoxybenzoin, acetylacetone, dimethylhydroresorcin, phenol, acetoxime, succinimide, phthalimide, ethyl mercaptan, hydrocyanic acid, and dimethylpyrone were investigated by a similar method, and their acidic strength determined. The result of this important investigation is to demonstrate in a brilliant manner the application of the ionic theory to solutions in absolute alcohol. F. G. D.

1556. *Oxidation- and Reduction-Potentials.* **K. Schaum** and **R. von der Linde.** (Zeitschr. Elektrochem. 9. pp. 406–409, May 7, 1903. Chemisches Institut, Marburg.)—Results are given of measurements of the potentials, with reference to a 1/10-normal calomel electrode at 25° and 50°, of platinised, non-ignited platinum electrodes in solutions containing various mixtures of ferrocyanogen and ferricyanogen ions. The values of the equilibrium constant are found to be moderately constant, if the molecular concentrations of the two salts and not the ionic concentrations are used in the calculation. The heat of the reaction $FeCy_6''' \longrightarrow FeCy_6''''$ is calculated by means of Helmholtz's equation (21,730 cal. per molecule), and also by van't Hoff's formula, $\log . K/K' = q/R(1/T - 1/T')$, which gives 21,670 cals. Similar measurements on mixtures of sulphite and sulphate did not yield satisfactory results. The addition of benzyl alcohol does not, as previously stated by the authors, accelerate the attainment of equilibrium at the electrode. T. H. P.

1557. *Electromotive Forces due to Mutual Actions of Saline Solutions.* **Berthelot.** (Comptes Rendus, 136. pp. 1109–1118, May 11, 1903.)—Further experiments, found to confirm the author's law that where E is the e.m.f. between an acid and a base, ε_1 that between the corresponding salt and the acid, and ε_2 that between the same salt and the base, $E = \varepsilon_1 + \varepsilon_2$; the solutions employed being dilute and containing equivalent quantities of the substances. The e.m.f. between acid and base corresponds to the heats of neutralisation; but where the electric energy is not derived from the chemical reactions, as where an acid and a salt are used, this relation between the e.m.f. and the heat of the reaction is no longer valid. The chemical action occurs in the walls of the porous jar where the two liquids come into contact, not at the surface of metal, as is the case where metal is dissolved in the cell. Electrical differences kept up not from chemical combination or other external source, but from diffusion of liquids, solution of gases, or the like, where the energy is taken from the surrounding medium, cannot keep up external electrolytic or other electric work; and in this category falls the case of e.m.f. due to contact between solutions of an acid or a base and a salt, which can keep up a real and continuous current, but not so as to produce any visible electrolytic production of gas. A. D.

1558. *Electrochemical Reduction of Certain Stilbene Derivatives.* **K. Elbs** and **R. Kremann.** (Zeitschr. Elektrochem. 9. pp. 416–419, May 14, 1903. Phys. chem. Universitätslaboratorium, Giessen, April, 1903.)—The authors have studied the electrochemical reduction of "Sonnengelb" (Sunyellow) in order to see if it has the constitution usually assigned to it, that of *p*-azoxystilbenedisulphonic acid. As the end product of the reduction of Sonnengelb, *p*-azoxystilbenedisulphonic acid, and also of *p*-dinitrostilbenedisulphonic acid, in alkaline solution, *p*-azotoluenedisulphonic acid is obtained; the ethylene linking is broken and the azo-group is reduced to the hydrazo-group. On exposure to the air the azo-group is again formed by atmospheric oxidation. *p*-Dinitrostilbene in alkaline solution gives *p*-azoxystilbene, but in acid solution, using the reduction method of Boehring, it gives *p*-diaminostilbene; under the same conditions *p*-dinitrodibenzyldisulphonic acid gives *p*-azodibenzyldisulphonic acid and *p*-diaminodibenzyldisulphonic acid respectively. Sonnengelb, on reduction in acid solution according to the method of Boehring, gives both *p*-diaminostilbenedisulphonic acid and *p*-toluidinsulphonic acid; under the same conditions *p*-dinitrostilbenedisulphonic acid gives practically only *p*-diaminostilbenedisulphonic acid. T. S. P.

1559. *Electrochemical Reduction of* m-*nitroacetophenone and* m-*nitrobenzophenone.* **K. Elbs** and **A. Wogrinz.** (Zeitschr. Elektrochem. 9. pp. 428–431, May 21, 1903. Phys. chem. Universitätslaboratorium, Giessen, April, 1903.)—The author has studied the electrochemical reduction of *m*-nitroacetophenone and *m*-nitrobenzophenone. The former can be readily reduced to *m*-azoacetophenone and *m*-aminoacetophenone. Experiments made to prepare *m*-azoxyacetophenone always gave mixtures of azoxy- and azo-compound. The reduction to the hydrazo-compound and the transformation to the corresponding benzidine are very imperfect. *m*-Nitrobenzophenone, on being electrochemically reduced, gives a very good yield of *m*-azoxybenzophenone, *m*-azobenzophenone, and *m*-aminobenzophenone. The hydrazo-compound is very readily oxidised, and the benzidine obtained by transformation has properties unfavourable for its purification. In no case was the carbonyl group found to be reduced. A. F.

1560. *Electrolytic Preparation of Persulphates.* **M. G. Levi.** (Zeitschr. Elektrochem. 9. pp. 427–428, May 21, 1903. Phys. chem. u. elektrochem.

Institut der techn. Hochschule, Karlsruhe, March, 1903. Extract from "Gazetta Chimica Italiana," 1903.)—The experiments were carried out with a solution of ammonium sulphate to which a little potassium chromate had been added. Blank platinum anodes were used, while the kathode consisted of either platinum, nickel, lead, or carbon. No diaphragm was used. The electrolyte was kept slightly alkaline during the course of the electrolysis by the addition of sulphuric acid. At temperatures of from 10–30° C. the yield of persulphate remains practically unaltered, and at 40° C. it begins to drop. In agreement with this the author finds that a 10 per cent. solution of ammonium persulphate, containing ammonia and ammonium sulphate, and in the absence of platinum, begins to decompose at 40° C. The material of the kathode appears to have very little influence on the yield, but carbon kathodes are apparently the best. The physical condition of the platinum anode, *i.e.*, whether rough or smooth, affects the yield considerably; smooth electrodes give the best results. Variations in the current density at the anode of 0·06–0·52 amp. per sq. dcm. have no appreciable effect on the current yield. T. S. P.

1561. *Electrochemical Analysis and the Voltaic Series.* **J. E. Root.** (Journ. Phys. Chem. 7. pp. 428–465, June, 1903.)—After discussing the theory of the electrolytic precipitation and separation of metals, and emphasising the importance of complex-formation in altering the "natural" voltaic series, the author determines the conditions of current, voltage, temperature, &c., for the precipitation of metals in solutions containing oxalates, tartrates, cyanides, and phosphates. From these "decomposition-potential" data the author draws up tables of the voltaic series of the metals in these various solutions. The paper forms a useful and timely contribution towards the putting of electrochemical analysis on a scientific basis. F. G. D.

1562. *Electrolytic Reduction of Unsaturated Acids.* **C. Marie.** (Comptes Rendus, 136. pp. 1331–1332, June 2, 1903.)—Aconitic acid can only be reduced electrolytically when a mercury kathode is used; platinum, copper, lead, &c., are not suitable for use in the place of mercury. The best conditions for carrying out the reduction are as follows: The solution of aconitic acid, to which has been added half its equivalent of caustic soda, is placed in a vessel, the bottom of which is covered with mercury to form the kathode; the anode consists of a piece of platinum-foil. The solution must be kept cold during the electrolysis, and the current density required is about 2 amps. per sq. dcm. The fixation of the hydrogen is not complete, a small quantity being continuously evolved. The carballylic acid produced can be separated from the aconitic acid by forming the copper salts; the salt of the former acid is insoluble in a dilute solution of acetic acid, whereas copper aconitate is soluble. The yield is about 60 per cent., the loss being caused by oxidation at the anode, with the formation of unsaturated hydrocarbons. If the solution is warm and alkaline, the amount of oxidation is increased. If, however, a more stable unsaturated acid, such as cinnamic acid, is used, the yield of the reduction product (in this case hydrocinnamic acid) is almost theoretical, no oxidation taking place at the anode, and the absorption of hydrogen being complete at the kathode. It is not practicable to use a porous cell with these acids, as diffusion through the cell takes place so readily. The diffusion of the acid, and consequent oxidation at the anode, can be prevented by using a dialyser; mercury, and the acid to be reduced, are put in the dialyser, forming the kathodic solution, while an alkaline solution outside the dialyser forms the anodic solution. The reduction by this method is not so vigorous as with the first method. In the case of aconitic acid the first method gives the better results in spite of the oxidation at the anode. T. S. P.

1563. *Electrolysis of Aqueous Solutions.* **C. Frenzel.** (Zeitschr. Elektrochem. 9. pp. 487–496, June 11, 1903. Techn. Hochschule, Brünn.)—On electrolysing solutions of ammonia or of the alkaline or alkaline-earth hydroxides, containing a non-polarisable kathode and a small anode, with a gradually increasing e.m.f., the curves representing the connection between the current passing and the e.m.f. applied, change their direction corresponding with the discharge of hydroxyl ions; as the e.m.f. is raised further the current at first increases, then remains constant or diminishes and finally increases again. The e.m.f. corresponding with the second increase of the current varies with the concentration of the hydroxyl ions, and when this is diminished to 1/10 the e.m.f. rises by 0·06 volt. The above changes only occur when the anode consists of a freshly ignited platinum wire, and if the same wire is used repeatedly the curves obtained become more and more continuous, and ultimately the current rises steadily with the e.m.f. The impurities in the salts used do not influence the form of the curve, which is not explainable by supposing a transient resistance to be introduced at the anode by the formation of a layer of gas. The most probable explanation is that the discharged hydroxyl ions and the molecular oxygen occluded by the electrode interact with formation of ozone. T. H. P.

1564. *Valve-Action and Pulverisation of Copper Anodes.* **F. Fischer.** (Zeitschr. Elektrochem. 9. pp. 507–509, June 18, 1903. Phys.-chem. Institut d. Universität, Freiburg, May 12, 1903.)—When a pure copper anode in the form of a wire 2 mm. thick is immersed to a depth of 10 mm. in sulphuric acid of maximum conductivity containing a copper plate as kathode, and an e.m.f. of 20 volts is applied, the anode undergoes pulverisation, forming a cloud of copper-coloured dust; a singing sound is heard and copper sulphate is formed in the solution. Using a gradually increasing e.m.f., the formation of a coating on the anode is observed, and, when about 20 volts is reached, this is suddenly pulverised, the current increasing at the same time to more than 50 times its initial value. A thermometer placed in a hollow kathode indicated 106–108° at this moment. The author supposes the anodic coating to consist of cuprous sulphate, which, owing to its high resistance, becomes heated until the liquid in its pores finally boils and so disperses it suddenly into the surrounding liquid, where it is decomposed into copper sulphate and metallic copper. On using as anode a copper tube cooled internally by a stream of cold water (at 8–10° C.), the pulverisation only takes place at a much higher voltage (48). The resistance of the anodic layer falls as the temperature rises and becomes zero at about 80°. With more dilute sulphuric acid than that of maximum conductivity, or with sodium sulphate solution, cuprous hydroxide is formed instead of copper. Aluminium behaves similarly to copper; if an aluminium anode in sulphuric acid is cooled internally, the badly conducting coating will resist a voltage of 200, whilst, if not cooled, it is broken down by 20 volts. [See Abstract No. 1114 (1904).] T. H. P.

1565. *The Thallium Accumulator.* **L. Jonas.** (Zeitschr. Elektrochem. 9. pp. 523–530, June 25, 1903. Physikalisch-chemisches Institut, Leipzig, April, 1903.)—The author has started to test the practical use of thallium for accumulators. The present paper contains a study of the application of Faraday's law, and the quantitative analysis of the oxides obtained at the anode in the electrolysis of solutions of thallium hydroxide. Further, there are given measurements of the e.m.f. of various thallium cells, and of the temperature coefficient. The composition of the oxide deposited at the anode is best represented by the formula $17Tl_2O_3 . Tl_2O$, but it was not tested whether this represents a definite compound or whether the composition varies with anode current-density or potential. The amount of this deposited is in agreement with Faraday's law. Assuming the composition Tl_2O_3, the reaction at the anode will be represented by—

$$Tl_2O_3 + 3H_2O - 4F = 2Tl^{\cdot} + 6(OH)',$$

and at the kathode by $4Tl + 4F = 4Tl^{\cdot}$. Hence for the e.m.f. we get $\pi = \pi_0 - RT/4F \log C^6_{Tl^{\cdot}} C^6_{(OH)'}$. This formula has been tested with solutions of different concentration, and the results found are in good agreement with the theory. The e.m.f. of the cell containing a solution $n/10$ $TlKO_3$, $n/100 NaOH$ was found to be about 0·61 volt. A. F.

1566. *Electromotive Behaviour of the Oxides of Cerium.* **E. Baur** and **A. Glaessner.** (Zeitschr. Elektrochem. 9. pp. 534–539, June 25, 1903. Königl. techn. Hochschule; anorg.-chem. Laboratorium, München.)—Measurements of the potential difference between platinum electrodes and solutions containing cerous and ceric sulphates and nitrates in various proportions, show that a cell having one electrode in a cerous solution and the other in a ceric solution would have an e.m.f. of about 0·6 to 0·7 volt, which would fall to 0·1 volt when 10 per cent. of the ceric salt had been converted into the cerous state and the corresponding quantity of the cerous salt into the ceric one. In alkaline solutions the differences between the potentials are much smaller. A solution of ceric peroxide in 50 per cent. potassium carbonate solution gives nearly the same potential difference with a platinum electrode as an alkaline solution of a ceric salt. Alkaline solutions of ceric salts are acted on by reducing agents very slowly at the ordinary temperature, but more rapidly at 70°. Ammonia is oxidised to nitrogen, and dextrose partially to carbon dioxide, but the potential differences between platinum and the ceric solutions show that equilibrium is not attained. Results are given of an examination of cells of the type Pt or Ni | cerous salt + reducer | ceric salt + oxygen | C, the reducing agent being dextrose, hydrogen, or sawdust, and the electrolyte 50 per cent. potassium carbonate solution. On taking a current of 0·002 to 0·004 amp. from the cells, the e.m.f. falls to a very small fraction of the original value. Sawdust has virtually no depolarising action, while cells with hydrogen or dextrose give twice or three times as great a current. The reaction between the solutions of the cerium salts and the depolarisers is, however, far too slow to give these cells any practical value. T. H. P.

1567. *Precipitation of Colloidal Solutions by Electrolysis.* **H. Freundlich.** (Zeitschr. Phys. Chem. 44. pp. 139–160, June 23, 1903.)—The author compares the precipitating power of various salts on colloidal solutions of arsenious sulphide, ferric hydroxide, and platinum, by measuring the concentration of the salt solution which, under constant conditions, causes a separation of flocks sufficiently large to be completely retained by a standard filter. The results show that the precipitating action cannot be explained by a displacement of the conditions of statical equilibrium, but only by some time-process, such as diffusion, as it is dependent not only on the concentration of the solution but also on the rate at which the electrolyte solution is added to the colloid. With colloidal solutions exhibiting anodic convection under the action of a current, the nature of the anion is without influence on the precipitating power, which is mainly determined by, and increases rapidly with, the valency of the kathion. With colloidal ferric hydroxide solutions, which display kathodic convection, the valency of the anion is the principal factor on which the precipitating power depends. In the case of the univalent ions, the migration velocity also comes into play; with colloidal solutions showing anodic convection the acids are better and the bases worse precipitants than the salts with univalent kathions, while with those exhibiting kathodic convection the reverse is the case. Equivalent quantities of electrolytes, which are dissociated to about the same extent and which yield ions having the same valency and the same rate of migration, have equally strong precipitating actions. The author suggests that the colloidal substance is semi-permeable to the ions, and that the nature of this semi-permeability bears a close relation to the direction of the convection.

T. H. P.

1568. *Electrolytic Equivalent of Silver.* **Pellat** and **Leduc.** (Comptes Rendus, 136. pp. 1649–1651, June 29, 1903.)—The authors have made a careful redetermination of this equivalent by the following method: The kathode of the coulombmeter was a silver basin, the surface being 300 sq. cm. The anode of electrolytic silver was 50 sq. cm. in area and covered with filter paper placed between muslin. The cell was filled with normal silver nitrate solution neutral to methyl-orange. Using 1 amp. the current density was about 0·002 c.g.s. per sq. cm. The electrolysis lasted two to three hours, 8–12 gm. of silver being deposited. The circuit comprised a rheostat and a resistance *r* of bare wire immersed in petroleum. The potential difference *ir* at the ends was opposed by a Latimer-Clark element, and the equality determined by a capillary electrometer. To find the absolute value of the current, the cell was replaced by an electro-dynamometer, and the same Latimer-Clark cell opposed by a potential difference IR of a second resistance R, allowances being made for change of temperature. Three determinations were made, preceded and followed by determinations of the Clark cell, whence the equivalent was found to be 0·011193, 0·011195, 0·011196 gm.; mean, 0·011195 gm.

F. S.

1569. *Electrolytic Dissociation of Picric Acid.* **V. Rothmund** and **K. Drucker.** (Zeitschr. Phys. Chem. 46. pp. 827–852, 1903.)—The electrolytic dissociation of picric acid in water was determined at 18° C. by measurement of the distribution of (undissociated) picric acid between water and benzene. The remarkable result obtained is that this strong acid obeys Ostwald's dilution law when the dissociation is measured in the manner indicated. Measurements of the dissociation founded on cryoscopic and conductivity determinations did not give constant values for the "dissociation constant," but as the degrees of dissociation found by the latter methods approximate to those obtained by the method of distribution, the want of constancy may be largely due to the well-known magnification of the experimental error involved in calculating the dissociation-constant. The authors discuss how far the apparent non-fulfilment of the mass-law in the case of strong binary electrolytes is really founded on fact, and conclude that in the case of acids whose concentration is under 0·05 normal, the deviations cannot be definitely said to be greater than such as might be produced by the experimental errors of the cryoscopic and conductivity methods. F. G. D.

1570. *Direct Reduction of Aromatic Halogen Derivatives by means of Hydrogen and Finely Divided Nickel.* **P. Sabatier** and **A. Mailhe.** (Comptes Rendus, 138. pp. 245–248. Observations by **Berthelot,** pp. 248–249, Feb. 1, 1904.)—The authors have studied the catalytic effect of reduced nickel on the reduction of aromatic halogen derivatives. The method used was to pass vapours of the different halogen compounds, mixed with excess of hydrogen, over the reduced nickel, which latter was heated up to a definite temperature. *Chlorine derivatives.*—At 160° C. mono-chlorbenzene is reduced to the hexahydrobenzene, none of the compound $C_6H_{11}Cl$ being produced. The chlorine is retained by the nickel, and after a time the activity of the latter disappears, as the nickel chloride produced is not further reduced by the hydrogen. If the temperature is raised to 270° C. the nickel chloride is reduced, there is an abundant evolution of hydrochloric acid gas, and benzene is formed. The yield of the latter is about 40 per cent., but this can be increased by lengthening the layer of reduced nickel used. Some diphenyl is formed at the same time. With the poly-substituted chlorine derivatives the reduction takes place in stages, and varying amounts of the successive reduction products are obtained. The presence of methyl or of hydroxyl groups in the nucleus facilitates the reduction; thus 2.4.6. tri-chlorphenol gives a 75 per cent. yield of phenol. This is also true of the amido derivatives; the chlor-anilines can be reduced at 200° C. In the case of the chlor-nitroanilines the nitro-group is reduced and the chlorine substituted at the same time. *Bromine derivatives.*—The reduction does not take place quite so readily as in the case of the chlorine derivatives. The results are similar. *Iodine derivatives.*—The reduction is much more difficult than in the case of the chlorine and bromine derivatives. At 270° C. iodobenzene is not reduced, except just at first when the nickel is fresh and has not been transformed into iodide. Nickel iodide is not reduced by hydrogen at this temperature in the presence of iodobenzene, although it is readily reduced by hydrogen alone. The reduction of the iodine derivatives could thus be brought about by passing them over the nickel alternately with a current of hydrogen. T. S. P.

1571. *Reduction by Alternating Currents.* **F. Pearce** and **C. Couchet.** (Comptes Rendus, 138. pp. 361–362, Feb. 8, 1904.)—The action of an alternating current may lead to (1) dissolution of the electrodes with formation of oxide or hydrate or (2) reduction of the dissolved salt. The former effect predominates with low-current densities, but as the current density increases the latter effect becomes more important. The cases studied were (1) the reduction of ferric alum, which occurs to a slight extent with platinum electrodes, but more rapidly with electrodes of aluminium, lead, or cadmium, and almost quantitatively with iron electrodes. (2) The reduction of alkaline nitrates to nitrites, which is almost quantitative with electrodes of cadmium or zinc, but almost zero with electrodes of iron, copper, or carbon. Other reductions that have been effected are those of (1) cupric to cuprous salts, (2) mercuric to mercurous salts, (3) chromates to chromic salts, and (4) nitrobenzene to aniline. T. M. L

1572. *Influence of Complex Ions in Electrolysis with the Alternating Current.* **A. Brochet** and **J. Petit.** (Comptes Rendus, 138. pp. 419–421, Feb. 15, 1904.)—The authors have examined the behaviour of electrolytes towards the alternating current when there is no possibility of the formation of complex ions; various electrodes were used. The observed phenomena can be divided into three classes: (1) With stable electrolytes (acids, salts, and alkalies), knall-gas is evolved and the yield is small. (2) In certain cases the electrode dissolves. (3) Sometimes the electrolyte is capable of oxidation or reduction, and this accordingly takes place. Occasionally all these reactions take place simultaneously or successively, and a state of equilibrium is reached which depends on the temperature, concentration, and current density. In the case of reduction the oxygen evolved often contains ozone. Stable electrolytes are such as sulphuric acid, alkali sulphates, chromates, chlorates, and perchlorates. Acids generally give more interesting results than the neutral salts. Sulphuric acid with mercury electrodes gives mercurous sulphate; lead gives lead sulphate. In the latter case, using acid of density 1·20, the yield is about 50 per cent. for a current density of 10–50 amperes per sq. decimetre; the yield falls rapidly with rise in temperature. The solution of the lead is probably due to the formation of persulphuric acid. Phosphoric acid, even in the cold, gives phosphate of lead, mixed in some cases with reduced lead. Arsenic acid gives lead arsenate, which is always mixed with lead and arsenic, and the hydrogen evolved contains abundance of arsine. Chloric acid gives traces of chloride. Neutral bichromate or chromate of potassium do not react with lead, but in the presence of sulphuric acid, sulphate and chromate of lead are produced; with chromic acid, reduction only takes place, the lead acting as a neutral electrode. Thus the presence of complex ions is not necessary in order to obtain reactions with the alternating current. The authors have also investigated the effect of the presence of complex ions which are not decomposed by the direct-current. Iron, cobalt, and platinum dissolve in cyanide of potassium with the formation of the complex cyanides. This is all the more remarkable as these metals are insoluble when used as anodes. In the case of cobalt and iron the yields are from 30–50 per cent. With platinum the yield is 15–20 per cent. [See also preceding Abstract.] T. S. P.

1573. *Importance of the Kathode Potential for the Electrolytic Reduction of Nitrobenzene.* **W. Löb** and **R. W. Moore.** (Zeitschr. Phys. Chem. 47. pp. 418–444, March 15, 1904. Extract of a paper by R. W. Moore, presented to the Worcester Polytechnic Institute, Sept. 28, 1903. Chem. Universitäts-Institut, Bonn, April, 1902–July, 1903.)—In order to come to some decision between the different views held with regard to the difference in action between soluble and insoluble electrodes, the influence of the different metals or the addition of salts to the electrolyte, in the electrolytic reduction of nitrobenzene, the authors have carried out a series of careful measurements with different electrodes. In the view of the authors the mechanism of the reduction is as follows: In the case of unattackable electrodes, the authors accept the assumptions of Tafel, according to which the ions, which are discharged at the kathode surface, either reduce the depolariser or are liberated in the molecular state at the electrode. The proportions in which these two processes occur will depend on their relative velocities. The velocity of formation of gaseous hydrogen depends, however, on the nature of the kathode metal, so that the views of Nernst (with regard to over-potential) lead to the same result. In the case of attackable electrodes the authors assume that the metal ions play the part of the hydrogen ions; that they are discharged at the kathode and, according to the relative velocities of the processes, reduce the depolariser and are deposited on the electrode. If the former of the two processes is relatively very rapid, no metal will be deposited on the electrode. This agrees with the authors' experiments. As a consequence of this view, the idea of "super-potential" becomes restricted, since in the case of reducing metals the hydrogen plays only a subordinate part. The specific effects of the different metals are accordingly not to be explained by super-potential. Lastly, since the osmotic pressure of the metal ions at the kathode surface, together with the solution pressure of the kathode, determines the potential, it follows that with the same potential the reduction energy must have the same value with all electrodes. This conclusion the authors' experiments have confirmed. The results of the experiments are as follows. A constant potential of 1·8 volts was employed.

No.	Kathode Metal and added Salt.	Axonybenzene. Per Cent.	Aniline. Per Cent.
1	Platinum	58·3	36·9
2	Copper	59·7	33·2
3	Copper + copper powder	40·6	52·6
4	Tin	62·6	28·0
5	Tin hydroxide	52·0	41·6
6	Zinc	49·3	40·8
7	Zinc hydroxide	59·4	30·1
8	Lead	60·4	30·0
9	Lead hydroxide	64·7	23·4
10	Nickel	62·1	34·9

They conclude, therefore, that with the same kathode potential, there are always formed the same products in similar amounts, no matter what the electrode used or what additions are made to the electrolyte; and that, therefore, the kathode potential is always the measure of the reducing energy.

A. F.

1574. *Theory of Amphoteric Electrolytes.* **J. Walker.** (Roy. Soc., Proc. 73. pp. 155–165, March 7, 1904.)—In this very important and interesting paper the theory of the state of solution of those substances (such as glycocoll and the amino-acids generally) which can act both as bases and acids is fully developed and applied to calculate the conductivities of the amino-benzoic acids. These were measured by Winkelblech [see Abstract No. 1554 (1901)], and found not to follow Ostwald's simple dilution law. The author now shows that this behaviour can be fully predicted from the theory, and his calculated values for the conductivities agree in a remarkable manner with those found by Winkelblech experimentally. The method pursued consists briefly in writing down the equations for the equilibrium between the various possible pairs of ions and deducing the logical consequences from these equations. The amphoteric electrolyte may be formulated as HXOH, giving the four possible ions, $\overset{+}{H}$, $\overset{-}{XOH}$, $\overset{-}{OH}$, $\overset{+}{HX}$. The whole paper forms a striking lesson to those people who, directly they encounter the slightest difficulty in applying the ionic theory, instead of quietly endeavouring to develop it, cast it aside at once as useless and with a great flourish of trumpets, set up some new theory better adapted to the calibre of their wits.

F. G. D.

1575. *Experiments on Thin-film Electrolysis, and a Proposed Application to Printing.* **C. R. Darling.** (Electro-Chemist, 3. pp. 564–659, March; Discussion, pp. 646–647, April, 1904. Paper read before the Faraday Society, March 21, 1904.)—A plate of metal, usually zinc, or of carbon is connected to the positive terminal of a source of electricity. Upon this is placed an impression pad, suitably consisting of six sheets of moistened blotting paper superposed. Upon this pad a trial sheet of paper, impregnated with a metallic salt is placed, and the type (consisting of a bar of linotype, a coin or metallic printing block) is connected to the negative terminal and impressed on the trial sheets for one or two seconds. An image of the type is thus formed on the trial sheet. The voltage varies, according to circumstances, from 6 to 200, but the results obtained do not differ with the voltage, except that a longer time of contact is required for a given effect when a lower voltage is used. The amount of current passing is very variable, depending on the area of the type in contact, on the thickness and dryness of the prepared paper and impression pad, and on the electrolyte present in the paper. The electrolytes used were silver nitrate and salts of copper, lead, bismuth, mercury, and manganese. In the case of silver the image produced is permanent, but the paper blackens on exposure to the light. With copper, lead, mercury, and bismuth, the print obtained fades away more or less quickly. With manganese salts, especially the nitrate, the print shows no sign of fading, even after five years. No satisfactory explanation of the fading of the prints can so far be given; it may be due to the recombination of the products of electrolysis. The process is not capable in its present state of superseding ordinary ink printing for general purposes. When a piece of moist paper is subjected in the usual manner to a current, using a coin or type as kathode, it is found that the paper has acquired the properties of a photographic plate which has been exposed. On treatment with a silver salt and a developer, such as hydroquinone, a perfect image of the coin or type is obtained at once. The name "electrograph" is suggested for the image produced in this way. The author finds that: (1) The "latent image" of the kathode is not due to metallic compounds, as the effect may be obtained when both anode and kathode consist of carbon. (2) The image, once formed, appears to be capable of development after an indefinite period. (3) The image resides in the upper surface of the paper which has been in contact with the kathode. If several layers of paper or of other fabric be superposed, the image may be traced downwards from the kathode through the sheets. (4) The presence of saline electrolytes in the film do not prevent the formation of the kathode image. A paper containing a manganese salt, for example, will yield a brown print; but on treatment with silver nitrate and hydroquinone the colour turns to black, owing to the liberation of silver. (5) The latent image of the kathode is not due to peroxide of hydrogen. (6) The kathode image, which gives rise to the electrograph, appears to belong to the same class of phenomena as the latent image in an exposed photographic plate, and those termed by Bose "the response of inert matter to electrical stimuli." In the *discussion,* the **Author** mentioned that he had investigated the use of organic substances, such as hydroquinone, in electrical printing, but he found that they invariably discoloured the paper after a time. Hydrogen is not the cause of the latent images; hydrogen peroxide does not destroy the latent image. In the production of electrographs the current is not transmitted by associated saline impurities, but by the colloids of the paper.

T. S. P.

1576. *Formation of Knallgas with the Alternating Current.* **R. G. van Name** and **L. Gräfenberg.** (Zeitschr. Elektrochem. 10. pp. 808–809, April 29, 1904. Elektrochemisches Institut, Göttingen.)—The authors have investigated the formation of Knallgas by means of the alternating-current in order to see if the method could be used to prepare this gaseous mixture on a larger scale, in preference to the methods using the direct-current. The electrolytes used were 20 per cent. sulphuric acid and potash of maximum conductivity (28 per cent.). With the former electrolyte, electrodes of carbon, graphite, crystallised silicon, lead, tin, *platinum*, *gold*, aluminium, and platinum-iridum alloy, and with the latter electrodes of carbon, graphite, silicon, lead, tin, platinum, gold, *silver*, *nickel*, iron, *copper* and zinc were tried. Quantitative measurements were only made with the substances in italics. The number of alternations per sec. was 110, and the current density was varied. The greatest observed efficiency was only about one half that attained with the direct-current; these efficiencies could only be maintained for a limited time owing to the electrodes being attacked. There does not seem to be a substance suitable for electrodes, which is not attacked when high current-densities are used with the alternating current. T. S. P.

1577. *Mechanism of the Electrolytic Oxidation of Sodium Thiosulphate.* **C. J. Thatcher.** (Zeitschr. Phys. Chem. 47. pp. 641–720, April 11, 1904.)—By means of platinised electrodes thiosulphate can be electrolytically oxidised to tetrathionate; the latter cannot be further oxidised, either in neutral or in acid solutions. Thiosulphate solutions are slightly alkaline, and as long as this degree of alkalinity is maintained, only the reaction $S_2O_3'' \longrightarrow S_4O_6''$ takes place. The formation of sulphur, sulphite, or sulphate in the electrolysis is due to side reactions, which can only take place in acid solutions, or in solutions which are more strongly alkaline than the solution of thiosulphate itself. These side reactions can be either chemical or electrical processes. The solutions used were electrolysed in an H-shaped vessel, between platinum electrodes; the anode served also as a stirrer, and the anodic solution was examined qualitatively, and as far as possible quantitatively. The number of coulombs used in neutral solution corresponded to the amount of tetrathionate formed within a few per cent. This is only the case as long as the initial potential does not exceed $-0{\cdot}644$ volt, and in order to obtain this the anode has to be treated in a special manner. The addition of calcium carbonate, or of a trace of iodide, to the electrolyte, produces a low and constant polarisation, and hinders the formation of sulphate. Traces of copper ions accelerate the production of sulphate. Sodium tetrathionate is reduced to thiosulphate by hydrogen in neutral or in alkaline solution, either in the presence or absence of platinum. Also an alkaline solution of tetrathionate gives thiosulphate, even in the absence of a reducing agent, hydrolysis being the cause of this reaction. Trithionate is formed, as well as thiosulphate, by the hydrolysis in alkaline solution; sulphite is either not formed at all, or only in traces. It is probable that tetrathionic acid is a hydrogen peroxide derivative of thiosulphuric acid. It is probable that the anodic oxidation of S_2O_3'' to S_4O_6'', which takes place between the potentials of $-0{\cdot}75$ and $-0{\cdot}95$ volt, is not a direct electrical action, *i.e.*, the discharge and union of two thiosulphate ions, but consists in a secondary chemical oxidation by means of an oxidising agent, probably oxygen, which is primarily formed electrolytically. The reaction is $2S_2O_3'' + \frac{1}{2}O = S_4O_6'' + O''$, and goes on in solution as long as this is kept slightly alkaline. The electrode discharges the O′ (or the OH′) ions, and thus makes further oxidation possible. The proof of this is furnished by two different methods. (1) By the observation of the effect of small quantities of undissociated platinum-poisons on the potentials of thiosulphate solutions it was shown that either oxygen, or a compound of oxygen, takes part in the reaction, and that the metal of the electrode acts catalytically. When a solution of mercuric cyanide is added to the anodic solution so that the latter contains 1 mol. of this salt in 40,000 litres, the polarisation of the anode, using a constant current, suddenly increases by 0·040 volt. This is readily explained by the author's theory of the mechanism of the reaction. (2) It can be shown by different methods that the anode is charged with oxygen. One of these is by the use of the Luther "layer-electrode" (Schichtelektrode), a full description of which is given. By means of this electrode it was shown that the process which goes on at the electrode consists in the discharge of hydroxyl or of oxygen ions. Measurements of the electrode potentials of thiosulphate-tetrathionate mixtures also showed that the potential was due to the electrode being charged with oxygen. It was also shown, that on account of the relatively slow velocity of the reaction $O_2 + S_2O_3''$ in the presence of platinum, the amount of oxygen with which the electrode was charged could be influenced by catalytic actions, and by the velocity with which the oxygen of the air diffused through the solution to the electrode. T. S. P.

1578. *Concentration of the Mercury Ions in the Calomel Electrode and the Solubility of Calomel.* **H. Ley** and **C. Heimbucher.** (Zeitschr. Elektrochem. 10. pp. 301–303, April 29, 1904. From the Chemische Instituten der Universitäten, Leipzig und Würzburg.)—Determinations of the solubility of calomel have hitherto been made by measurements of the e.m.f. of combinations of the normal electrode with a mercury electrode containing mercurous nitrate and an excess of nitric acid. The results vary between $1·0 \times 10^{-6}$ and $1·6 \times 10^{-6}$ for the solubility in pure water, and, furthermore, they do not agree with the value $6·0 \times 10^{-6}$ found by Kohlrausch and Rose from conductivity determinations. The latter value is too high because of the hydrolysis which takes place. The difference in the former values probably depends on the fact that the concentration of the mercurous ions in the electrode combined with the normal electrode is not accurately known; also the potential difference caused by the excess of nitric acid necessary to keep the basic mercurous nitrate in solution has not been sufficiently taken into account. The authors use an 0·1 equivalent solution of mercurous perchlorate in the place of nitrate, since it is strongly dissociated, and, moreover, forms soluble basic salts. The dissociation was calculated from conductivity measurements, the hydrolysis being allowed for. The latter was determined by the velocity of the inversion of cane sugar, and found to be 0·034 per cent. in a 0·1 equivalent solution. The concentration, expressed in mols., of the mercurous ions in the same solution is 0·035. The e.m.f. of the chain formed by the combination of this electrode with a normal electrode containing 0·1*n*.KCl, the two electrodes being separated by a 0·1*n*.KNO_3 solution, was found to be 0·4193, 0·4197, 0·4200, and 0·4199 volt respectively in four different experiments; in combination with a normal electrode containing 1·0*n*.KCL, the values were 0·4721 and 0·4717 volt respectively, in two different experiments. The corresponding e.m.f.'s using mercurous nitrate instead of the perchlorate are 0·391 and 0·444 volt; 0·005 volt has to be added to allow for the e.m.f. caused by the diffusion of the perchloric acid (formed by hydrolysis) at the surface of contact of the electrolytes. The concentration of the mercurous ions is then calculated to be $2·0 \times 10^{-16}$ in normal elec-

trodes containing 0·1*n*.KCl, and $3·5 \times 10^{-18}$ in the electrode containing 1·0*n*.KCl. Assuming that the calomel is completely dissociated the values calculated for the solubility are then $0·72 \times 10^{-6}$ and $0·79 \times 10^{-6}$ respectively.
T. S. P.

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1579. *Europium.* **G. Urbain** and **H. Lacombe.** (Comptes Rendus, 138. pp. 627–629, March 7, 1904.)—Particulars are given with regard to the separation of this element from samarium and gadolinium; and the atomic weight, obtained by three different methods, is estimated at 151·79. G. E. A.

1580. *Complex Nature of Thorium.* **B. Brauner.** (Nature, 69. p. 606, April 28, 1904.)—A note on some previously published experiments of the author, which indicate the probability that thorium is composed of two constituents. J. J. S.

1581. *The Part Played by Benzene in Poisoning by Coal-gas.* **R. Staehelin.** (Roy. Soc., Proc. 73. pp. 78–83, Feb. 24, 1904. Chem. News, 89. pp. 74–76, Feb. 12, 1904.)—Coal-gas produces first excitation and then rigor of the isolated frog's muscle. Frogs exposed to coal-gas show excitatory phenomena, which are absent when the animal is placed in an atmosphere of nitrogen or carbon-monoxide. These specific effects are removed by passing the gas through oil, which removes the small quantity of benzene it contains. Precisely similar phenomena can be produced by air containing the same percentage of benzene. The author concludes that the difference between intoxication by coal-gas and that by carbon-monoxide is entirely due to the influence of this substance. H. W. P. Y.

1582. *Specific Gravity of Zinc Chloride.* **G. P. Baxter** and **A. B. Lamb** (Amer. Chem. Journ. 31. pp. 229–235, 1904.)—Dry zinc chloride was prepared by heating the pure double zinc ammonium chloride $ZnCl_2$, $3NH_4Cl$, first in a current of dry hydrochloric acid, then in nitrogen, and finally in air. The sp. gr. was determined in a modified form of pyknometer by means of toluene, in which zinc chloride is insoluble. The mean value of the sp. gr. found was 2·907. L. H. W.

1583. *Electrical Resistance Ovens.* **A. Kalähne.** (Ann. d. Physik, 11. 2. pp. 257–269, May, 1903. Physik. Inst. d. Univ., Heidelberg, Jan., 1903.)—The author gives the data necessary for finding the quantity of energy required to heat up ovens of given dimensions to a definite temperature. The data are only approximate, since they depend on the loss of heat due to radiation and convection. A description of the method of making the ovens is also given. [See also Abstracts Nos. 1913 and 2355 (1901).] T. S. P.

1584. *Gaps in the Mixture Series with Isomorphous Substances.* **W. Stortenbeker.** (Zeitschr. Phys. Chem. 43. pp. 629–633, May 12, 1903.)—Van't Hoff has stated that the resemblance of solid solutions is most striking in the case of isomorphous mixtures, the miscibility being sometimes complete and sometimes incomplete. The author, however, expresses a doubt as to the validity of this analogy, and refers to several cases in point. A gap exists in the mixed-crystal series of potassium and thallium nitrates, and, if these substances are isomorphous, as is usually supposed, support would be given to the above analogy. But, according to the author, they are isodimorphous, and it is possible to obtain a potassium nitrate solution which will remain supersaturated when a crystal of thallium nitrate is added to it. Possibly potassium and thallium chlorates are also isodimorphous. T. H. P.